FACTORS INFLUENCING 21ST CENTURY SKILLS DEVELOPMENT SUSTAINED BY ICT

by

Erna Laubscher

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Supervisor: Prof. Dr JG Knoetze

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[1] Kafka, *The Castle*
[2] From J.R.R. Tolkien, *The Lord of the Rings*
[3] Sylvia Plath, *The Bell Jar*
[4] Chuck Palahniuk, *Fight Club*
[5] Patrick Süskind, *Perfume: The Story of a Murderer*

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[6] Gogol, *Diary of a madman and other stories*

Declaration

1. I understand what plagiarism is and am aware of the University's policy in this regard.

2. I declare that this dissertation is my own original work. Where other people's work (either from a printed source, Internet or any other source) has been, used this has been properly acknowledged and referenced in accordance with departmental requirements.

3. I have not used work previously produced by another student or any other person to hand in as my own.

4. I have not allowed, and will not allow, anyone to copy my work with the intention of passing it off as his or her own work.

SIGNATURE

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List of acronyms

DoE	Department of Education
ICT	Information and Communication Technology
IEA	Association for the Evaluation of Education Achievement
IEA DPC	IEA Data Processing and Research Center
IEA IDB	IEA International Database
SITES 2006	Second Information Technology in Education Study[7]
SPSS	Statistical Package for the Social Sciences
WinDem	Windows Data Entry Manager

[7] The data for the study was collected in 2006 (Brese & Carstens, 2009, p. 10)

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Abstract

As technology development is advancing almost exponentially, it has since touched almost every aspect in our lives, from work to recreation. Therefore, in view of the extent to which technology is integrated in modern socio-economic settings, this study undertook to investigate South African schools readiness to integrate ICT. The following research questions were investigated: *What is the relationship between the importance of ICT use for 21st Century Skill Development and obstructions hindering ICT goals in the light of currently available Infrastructure in South African schools? What is the relationship between the importance of ICT use for 21st Century Skill Development and obstructions hindering ICT goals in the light of currently available Human Resources in South African schools?* A Spearman's rho correlation was calculated, using SITES 2006 data obtained from the Principal Questionnaire (Brese & Carstens, 2009). It was found that all of the influencing factors, pertaining to both Infrastructure and Human Resources, showed a weak, to very weak negative correlation with the ICT goals under question. This means that, though the relationship is not strong, the influencing factors are hindering schools from reaching ICT goals for 21st Century Skills Development.

Key words: obstructions, influencing factors, SITES 2006, 21st Century Skills, ICT, Human Resources, Infrastructure, technology, development, Spearman's rho

Chapter 1

Introduction

1.1 Introduction

In 2004 the Department of Education (DoE) published the *White Paper on e-Education,* promising radical change in education through Information and Communication Technologies (ICTs) (DoE, 2004, p. 3). Considering what was planned at the time, not much has been accomplished. For ICT goals to be reached appropriate steps need to be taken. The question is whether South Africa will be able to take these steps at all. This study investigates South African schools' readiness to implement ICT for 21st Century Skills Development, given the current state of the available Infrastructure and human resources.

To realise the objectives of this study, data from the Second Information Technology Study (SITES 2006) were analysed to determine if significant relationships exist between the variables *obstacles* and *importance of ICT use*. Reporting on the previous SITES studies (SITES Module 1 and SITES Module 2) Pelgrum (2001, p. 173) found that the three greatest obstructions hindering ICT-related goals in lower secondary schools are the following:

- Insufficient number of computers
- Teachers' lack of knowledge/skills
- Difficulty to integrate ICT in instruction

The current study endeavours to provide more insight into such influencing factors (obstacles identified for SITES 2006) in relation to the importance of ICT use for 21st Century Skills Development. Inferential analysis of indicators from the two SITES questionnaire items

has been carried out by means of Spearman's rho analysis. This has yielded sufficient information to answer the research questions.

1.2 Theoretical framework

This study utilises Activity Theory[8] as a theoretical framework. Figure 1.1 illustrates the First Generation Activity Theory Model.

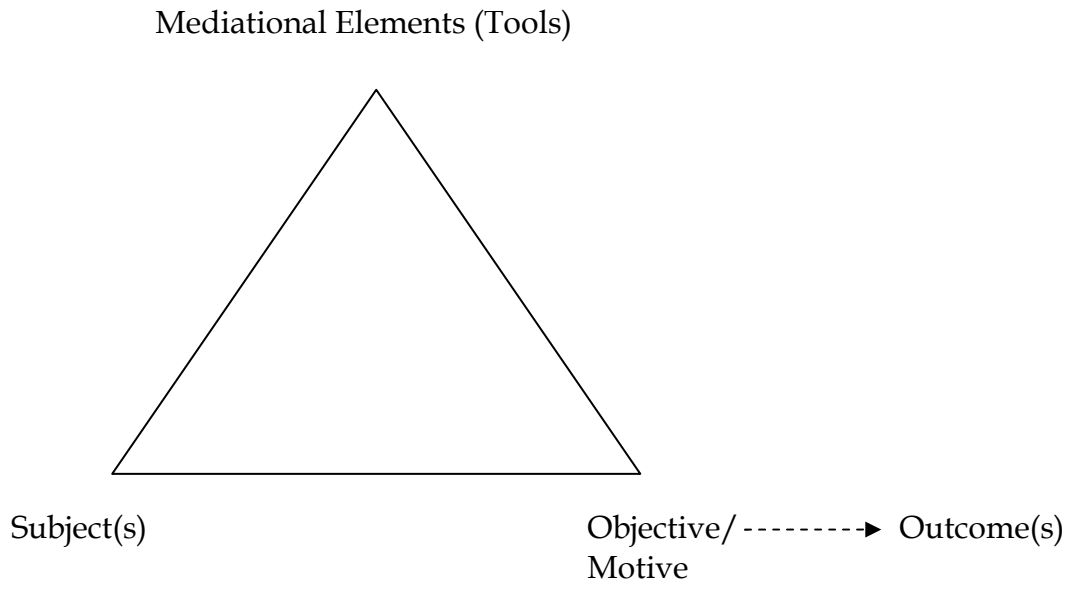

Figure 1.1: First Generation Activity Theory Model Based on Vygotsky (1978)

The diagram of Vygotsky (1978) was adapted as follows:

- *Subject* represents the school principal.
- *Objective/Motive* is the 21st Century Core Subjects (see Trilling & Fadel, 2009). The two subjects applicable to the current study are Mathematics and Science.

[8] Vygotsky (1978).

- *Tools* (factors influencing the outcomes) contain the dependent variables listed under the questionnaire item *obstacles to ICT implementation*. These factors influence the subject's success in achieving the outcomes. They relate to:
    - *Infrastructure* (insufficient ICT equipment; insufficient digital educational resources and computers being out of date)
    - *Human Resources* (insufficient qualified technical personnel and teachers lacking skills)

  In other words, the current state of Infrastructure and human resources has an impact on the development of 21st Century Skills that are supported by ICT. This study investigates the nature of this impact.

- *Outcome* includes these independent variables from the questionnaire item *importance of ICT use:*
    - Prepare learners for the world of work.
    - Promote active learning strategies.
    - Foster collaborative and educational resources.
    - Develop independence and responsibility for own learning.

  Ultimately, the use of ICT should enable the development of these 21st Century Skills.

Figure 1.2 demonstrates the application of the First Generation Activity Theory in the current research.

1.3 Description of dissertation title

The dissertation title – *Factors influencing 21st Century skills development sustained by ICT* – is clarified in this section. The title is divided into segments and explained accordingly. This explanation provides the reader with an idea of what the research entails.

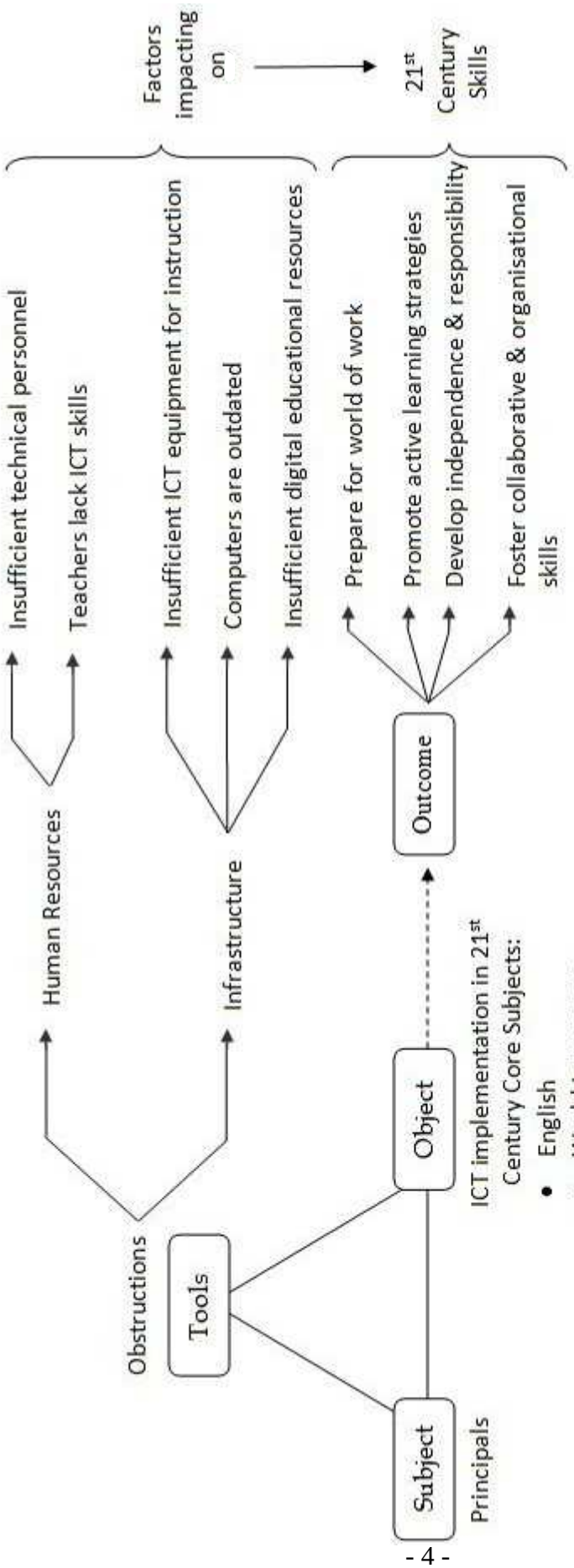

Figure 1.2: Application of First-Generation Activity Theory

1.3.5 *Factors influencing …*

For the questionnaire item *obstacles to ICT implementation* the following items, adapted from Brese and Carstens (2009, p. 84), have been included in the present study and serve as the independent variables in the inferential analysis. They are listed in Table 1.1.

Table 1.1: Obstructions to ICT implementation

Infrastructure (Hardware)	Human Resources
Insufficient ICT equipment for instruction	Insufficient number of qualified technical staff members who can support ICT use
Computers are outdated	Teachers' lack of ICT skills
Insufficient digital educational resources for instruction	

As mentioned in 1.2, the variables were grouped as *Infrastructure* and *Human Resources*. Question 16[9], from which the items in Table 1.1 were sourced, included other items that are related to software, Internet usage and more. However, due to the limited scope of the study, only items related to hardware were selected for studying current ICT infrastructure.

1.3.1 *21st Century skills …*

Trilling and Fadel (2009, p. 48) summarise the 21st Century Skills in a rainbow-shaped model. These skills are career skills; learning and innovation skills, and information, media and technology skills, which are to be taught by means of "[c]ore subjects and 21st century themes". To investigate the *importance of ICT use* in 21st Century Skills Development, the following variables were used (adapted from Brese & Carstens, 2009, p. 72):

[9] Brese & Carstens, 2009, p. 84

- To prepare students for the world of work
- To promote active learning strategies
- To foster collaborative and organisational skills when working in teams
- To develop students' independence and responsibility for their own learning

The influence of technological development in modern economies is evident in everyday life – transportation, communication, work and many forms of recreation. For the average person to share in the possibilities and convenience that technology offers, at least some level of technical knowledge is needed. Of course, not everyone has access to technological innovation; consequently the technology culture is shared by the limited number of people not left behind in the *digital divide*. For learners to be successful in work and life in the modern economy, 21st Century Skills need to be integrated into our education systems.

1.3.2 *… development …*

The word *development* is defined by the Oxford Dictionary of English (Stevenson, 2010) as "a specified state of growth or advancement" and "an event constituting a new stage in a changing situation". The main idea conveyed in these definitions is that of *change – moving towards something different*.

Education is not only about the acquisition of knowledge, but also about learning how to use information. Information processing technologies are changing how we work with information. In modern economies, more often than not, information is searched for, stored, processed and retrieved electronically. Logically this has implications for what should be learned in schools, and how. Start-up investments in ICT are extremely costly and so it is important to maintain it once the investment has been made. This brings the present discourse to the next element, *sustained*.

1.3.3 *… sustained by …*

The Oxford Dictionary of English (Stevenson, 2010) defines the word *sustained* as "cause to continue for an extended period or without interruption". Once implemented, ICT use and development should be continuous. Only then can schools truly gain from the benefit that ICT has to offer, without wasting resources.

Not only does school management need to provide the right guidance and resources continuously but it should also to maintain an environment that allows teachers to take responsibility for ICT implementation and to integrate it in their pedagogical practices by means of proper training and sufficient educational equipment. Principals, teachers and learners would be more motivated to make ICT initiatives succeed if they take ownership of such initiatives.

1.3.4 *… ICT …*

ICT generally includes all tools and applications related to information and communication technologies, such as mobile phones, tablets, instant messaging and smart boards. For the purpose of the current study ICT refers to computers only, as was the case for SITES 2006 (See Brese & Carstens, 2009, p. 68). Since the current study has utilised data from SITES 2006, this constraint was automatically imposed on the current study's scope.

1.4 Problem statement

Many educators take on ICT-integration initiatives enthusiastically, but ever so often their enthusiasm starts to wane as soon as they run into obstructions and barriers during the implementation process. For SITES 2006 possible obstacles (see Addendum A) to reaching ICT-related pedagogical goals have been identified. They are included in the Principal Questionnaire[10], which contains questions regarding the importance of ICT use in schools (Addendum A).

[10] Brese & Carstens, 2009, p. 67

A descriptive analysis of the SITES 2006 data has revealed that the majority of South African school principals agree that ICT use is important for various education-related activities and functions. However, if school principals regard ICT use in school as important, but its implementation is slow or non-existent, potential obstructions to its implementation need to be investigated.

Looking at currently available Infrastructure and Human Resources, the question arises whether or not South African schools are ready at all to implement ICT. In other words, it is still unclear whether or not these factors influence schools' attempts to achieve important ICT implementation goals.

1.5 Purpose statement

In investigating South African schools' readiness to implement ICT for 21st Century Skills Development, the study proposes to determine what the relationship is between the importance of ICT use in schools and obstructions hindering ICT goals for learners in their eighth school year, as expressed by school principals. Based on the results, South African schools' readiness to integrate the teaching of 21st Century Skills is discussed in the light of the currently available Infrastructure and Human Resources, using First Generation Activity Theory[11] as a framework.

1.6 Research questions

This study endeavours to answer the following questions:

- What is the relationship between the importance of ICT use for 21st Century Skills Development and obstructions hindering ICT goals in the light of currently available *Infrastructure* in South African schools?

[11] Vygotsky (1978)

- What is the relationship between the importance of ICT use for 21st Century Skills Development and obstructions hindering ICT goals in the light of currently available *Human Resources* in South African schools?

1.7 Rationale

Since ICT is a driving force in the modern economy, one cannot ignore the need to integrate it fully into our education system. It is quite alarming that so many education systems across the globe still lack ICT integration today. Reported by The Economist Intelligence Unit (Economist Intelligence Unit, 2010, p. 4), South Africa was ranked 40th out of 70 countries listed on the Digital Economy Rankings – originally called 'e-readiness' scores – in 2010.

The scores for the Digital Economy Rankings were determined by evaluating the development of ICT in 70 of the world's greatest economies. Connectivity and technology infrastructure, government policy and vision, and business environment, among other aspects, were examined. With South Africa ranking 40th, there clearly is a need to determine how and why so little development has taken place in comparison to other countries.

For South African education to move forward we need to look at what is holding it back. Through analysis of selected SITES 2006 data[12], this study takes a look at what the situation in South African education is by determining the direction of the relationship between ICT activities that are seen as important and factors influencing ICT integration, as according to school principals. Knowledge gained through the study can help school management and the DoE take more informed decisions when planning ICT implementation projects in the future. Potential and current obstructions to implementation can be targeted and solutions can be planned accordingly.

For the SITES 2006 study 15 indicators were investigated in Question 16 of the Principal Questionnaire[13], of which five were analysed for this study. They are mainly related to

[12] Brese & Carstens, 2009
[13] Brese & Carstens, 2009, p. 84

Infrastructure and Human resources. By determining whether or not there exists a dependency between these indicators (influencing factors) and the importance of ICT use, the study can point out if ICT use, and therefore the importance of its implementation, is influenced by the factors under question.

1.8 Significance of the study

This research attempts to add to the literature by investigating the importance of ICT use for 21st Century Skills Development and factors influencing ICT integration, specifically in Mathematics and Science for learners in their eighth school year as seen by school principals in South Africa.

Policy makers and school governing bodies would be able to benefit from the findings of the study in that it could provide insight into factors affecting the implementation of and change towards ICT integration in schools. Furthermore, teachers need to be aware of the state of ICT in education today and have clear guidelines for successful ICT integration development insofar the available Infrastructure and Human Resources allow.

For this reason studies such as this one are important. It attempts to provide a context and a realistic view of what is happening in practice so that decision-making bodies, and those who have to execute decisions, can find common ground – where expectations of the different decision makers are made clear and attainable goals are defined, more informed choices can be made in favour of successful change.

The study attempts to address factors influencing ICT use in terms of important ICT goals for Grade 8 Mathematics and Science learners, according to school principals. Cultures within an educational system, as well as the culture of ICT use in a specific country, can determine which influencing factors its schools might encounter. This is why it is important to look at individual education systems.

1.9 Assumptions

This study assumes that the data pertaining to principals' views on ICT implementation are representative of the entire education system at large in that at least the majority of schools would want to implement ICT and that there exists a need to investigate what is holding them back.

1.10 Limitations and delimitation

Since this is a secondary data analysis and the original participants were not directly involved in the current study, the study is constrained by the limitations of the original research, for example possible sources of error, data being limited to the original number of participants and the profile of the sample. The researcher had to rely on the International Association for the Evaluation of Educational Achievement's (IEA) standards for ensuring validity of the data, data collection methods, quality control methods and so forth.

The sample is limited to teachers teaching Mathematics and Science to learners in Grade 8, making transferability of the results to other grades and school subjects questionable. Furthermore, the financial and logistical circumstances vary greatly within South African schools based on their location – that is, between provinces, as well as rural versus suburban schools. Therefore, effective solutions to problems for one school might not work for another.

Since the Department of Statistics at the University of Pretoria offer its services for larger research projects than the current study only, the data were analysed by the researcher herself, drawing on knowledge from academic articles, statistics textbooks and the researcher's supervisor. Though the researcher is confident that the analysis was conducted correctly, this point has to be taken cognisance of.

1.11 Structure of chapters

The dissertation is divided into five chapters. The first chapter contains an introduction, outlining the background and direction of the study. Chapter 2 presents an overview of the literature that serves to clarify the central themes of the study and discusses related research. Chapter 3 provides a description of the research design and methods used to conduct the research. Chapter 4 is devoted to data gathering and analysis and the results are presented with a discussion thereof. The concluding chapter contains a summary and recommendations for further research.

Chapter 2

Literature review

2.1 Introduction

Chapter 2 firstly provides a discussion of Secondary Data Analysis (SDA) research. Then a literature survey pertaining to SITES 2006 follows. Next the concept of 21st Century Skills is briefly discussed, for which Trilling and Fadel (2009) served to clarify the concept. Lastly, the discourse deals with influencing factors in ICT implementation.

2.2 Secondary data analysis

When conducting a secondary analysis the researcher uses data captured for the purpose of previous research. Grinyer (2009, no page) suggests that the researcher might choose to use data from a previous study conducted by the researcher self (that is, returning to the initial data), or it might have been collected by a different researcher for a study in which the current researcher was not involved. Existing data can be reanalysed, thereby testing hypotheses or validating models, according to Mouton (2001, p. 164).

Mouton explains that secondary analyses are usually applied when analysing census data, survey data and for market analysis. Struwig and Stead (2001, p. 80) broadly classify secondary data into three categories: (i) raw data that has already been collected; (ii) summaries of numbers; and (iii) written treatises.

Using data collected for the research purpose of a different study naturally has implications pertaining to the research questions (Blaxter, 2007, no page), research ethics (Thomson, Bzdel, Golden-Biddle, Reay & Estabrooks, 2005; Grinyer, 2009; Carusi & Jirotka, 2009;

Heaton, 1998) and the context (Bishop, 2007; Van Den Berg, 2005; Kelder, 2005) of both the previous and the present study.

According to Blaxter (2007, no page) the researcher might encounter significant problems when the research questions differ from the original questions in the secondary study. After all, the data for the original study were collected in order to answer a completely different set of research questions. To avoid the research effort being obsolete, the ability of the data to answer the new research questions must be evaluated.

Looking at ethics, Thomson et al. (2005, no page) express the need to "… find a balance between honouring commitments of confidentiality made to participants […] while still retaining the usefulness of the data …" when removing information that can identify any research participants. However, the authors mention that valuable contextual information might be lost when identifying information is discarded.

Understanding the context of the original research effort, as Blaxter (2007, no page) explains, is one of the difficulties of secondary analysis. The researcher should not make unfounded assumptions about the context, as well as the circumstances and the research participants. If the data are not accompanied by an informative research report and clarity is needed regarding any aspect of the prior study, the original researcher(s) should be contacted for advice, if possible.

Other potential problems that can be encountered when using secondary data might include the fact that the researcher is not able to control data collection errors (Mouton, 2001, p. 165). Mouton mentions misunderstanding of the original objectives of the original researcher. This can be avoided if a comprehensive report accompanies the data. A good example is the SITES 2006 user guide that was written for the international database (Brese & Carstens, 2009), combined with the SITES 2006 technical report (Carstens & Pelgrum, 2009).

According to the literature, clear guidance on various aspects of SDA is still lacking in policy and guidelines. Carusi and Jirotka (2009, p. 288), for example, confirm that the concept of *informed consent* is still not clearly defined, specifically when it comes to data archived on the Internet. They suggest that for informed consent to be upheld, research participants should have the right to withdraw their archived data when they wish not to contribute to further research.

Evidently, secondary analysis research does not come without potential pitfalls; however, there are valuable advantages which make it a clear choice for some research projects. For one, if the data needed to answer the research questions have already been collected during a previous study, there is no need for the researcher to spend time and money to collect it again.

Avoiding repetition is one of the reasons Carusi and Jirotka (2009, p. 286) give for the publication and archiving of data. It assists transparency of research (Caursi & Jirotka, 2009), as it allows results and interpretations to be assessed and tested, and either supported or challenged by other researchers.

The data might be difficult to capture; as Kelder (2005, no page) points out, the research participants are difficult to find/access (Heaton, 1998, no page) or as time goes by the social context in which the topic can be researched does not exist anymore, as mentioned before. The latter makes secondary analysis ideal for longitudinal studies, historical research (Corti & Bishop, 2005) and for studying social change (Bishop, 2007).

Even if it would be possible to access the research participants, conducting a secondary analysis can help the researcher avoid unnecessarily burdening them (Heaton, 1998; Kelder, 2005), especially if there are time or financial constraints.

Conducting a secondary analysis can also save time and money (see for example Mouton, 2001; Kelder, 2005) and at less cost several types of data can be combined (Bishop, 2007, no

page). For these reasons, secondary analysis can be ideal for the novice researcher who can learn and benefit from the work done by more experienced academics.

2.3 SITES 2006 research published in South Africa

Section 2.3.1 provides a discussion on an article published on South Africa's participation in the SITES 2006 study, as the title suggests.

2.3.1 Contextualising South Africa's participation in the SITES 2006 module

Blignaut, Els and Howie (2010, p. 555) attempted to place South Africa's participation in SITES 2006 in context by reporting on the following:

> "… (i) the nature and structure of the South African education system, (ii) a review of South Africa's participation in SITES 2006, (iii) ICT infrastructure, facilities and equipment, and (iv) teachers' use of ICTs for teaching and learning".

This qualitative study underscores the significant challenges that the South African education system faces regarding ICT-implementation (Blignaut et al., 2010, p. 564). The authors explain how ICT infrastructure is sorely deficient (pp. 564-565) and point out that most teachers still rely on old ways of teaching (pp. 566-567). Furthermore, learners are missing out on sharing in the advantages of the information age (p. 567). This is the case despite the aspirations of ICT-integration in our schools, as is stipulated by the White Paper on E-Education (DoE, 2004).

By means of descriptive statistics Blignaut et al. (2010, p. 567) report that ICT is used between 9% to 18% of the time by South African Mathematics and Science teachers for various activities, such as remedial instruction, assessment and classroom management.

With regard to ICT competency, many teachers lack the ability to apply ICT in their daily practice. Furthermore, the authors reported among other indicators, the following (p. 567):

- 50.7[14]% of Mathematics teachers and 50.8% of Science teachers are unable to prepare lessons that implement the use of ICT.
- Only 46.7% and 45.5% of Mathematics and Science teachers respectively can identify suitable situations for using ICT and fewer than 50% of teachers can perform basic searches on the Internet.

Though the article reports on some aspects of ICT use in South African Mathematics and Science classrooms, no inferential statistical analysis has been conducted using the SITES 2006 data.

2.4 International SITES 2006 publications

In the following section, international studies that utilised SITES 2006 data are discussed.

2.4.1 Pedagogy and ICT use in South African Science education

Draper, Howie and Blignaut (2008, p. 4) conducted a secondary data analysis using data from SITES 2006. They attempted to answer the following research questions:

- What are Science teachers' pedagogical practices when they use ICT to teach Science?
- What factors may be used as predictors of ICT use in South African Science classrooms?
- In what ways does the use of ICT in large, poorly resourced Science classrooms provide opportunities for learners to learn Science that would not be possible without ICT?

[14] South African language practices prescribe the use of the decimal comma. However, to conform to APA standards, the decimal point is used throughout the text.

In this investigation on how ICT is used and in determining predicting factors of ICT used by Science teachers, Draper et al. (2008) reported on Law, Pelgrum and Plomp (2008), giving the percentages and mean scores of the following three core indicators: (1) teachers' curriculum goals (p. 4); (2) teachers' practices (p. 5); and (3) learners' practices (p. 5).

Draper et al. (2008, p. 4) reported that "to increase learning motivation, to prepare students for further education and to improve assessment performance" have been ranked as the most important teacher curriculum goals by South African Science teachers. Regarding South African Science teachers' practices, classroom management, their presentation of information/demonstrations, or giving class instruction and to assess learners' learning were rated as the most important (p. 5). Lastly, the three highest ranked learner activities were completing worksheets/exercises, working at the same pace/sequence and answering tests (p. 5).

As Draper et al. (2008, p. 5) remark, these activities clearly are in line with traditionally important goals and traditional roles played by teachers and learners. Since this article is part of a PhD study, more comprehensive results will be presented in the final published work.

2.4.2 South Africa's readiness to integrate ICT into Mathematics and Science pedagogy in secondary schools

Using descriptive statistics, Howie and Blignaut (2009 p. 345) report on South African schools' preparedness to integrate ICT in eighth grade Mathematics and Science classrooms. The report attempts to answer two research questions: "1. [T]o what extent is South Africa adequately prepared to integrate ICT into Mathematics and Science Grade 8 classrooms [?] 2. To what extent is ICT integrated in South African Mathematics and Science Grade 8 classrooms?" (p. 348).

Comparing South African data with various other countries (including Chile, Thailand and Norway) it was found that 62% of South African schools still do not have access to computers, whereas 96% of both Thai and Chilean schools enjoy access to ICT (Howie & Blignaut, 2009, p. 353). All the participating schools with computer access also have Internet access – except for the Russian Federation and South Africa (p. 353).

2.4.3 Factors predicting the impact of ICT-use on learners: an exploration of teachers' perceptions

Yuen, Lee, Law and Chan (2008, p. 1) investigated teachers' perceptions of "… factors associated with the impact of ICT use on students' 21st century skills …". To this end a secondary data analysis from the SITES 2006 teacher questionnaire data was conducted. The authors described the sample size: 35 567 teachers from 8 702 schools; schools from twelve out of the 22 education systems were included in the sample – Catalonia, Chile, Chinese Taipei, Finland, Hong Kong SAR, Israel, Italy, Japan, Ontario Province, Slovak Republic and Slovenia (p. 1).

Yuen et al. (2008) hypothesised a model that attempted to explain the impact of factors on learners' 21st Century Skills according to teachers' perceptions. The authors identified two groups of factors: Consisting of teachers' perceptions, the first group included (1) teacher-practice orientation of 21st Century learning; (2) learner-practice orientation of 21st Century learning; (3) pedagogical competence. Then teachers' perceptions of (4) professional collaboration and (5) teacher-related obstacles in using ICT fell in the second group (Yuen et al., 2008, pp. 2-3).

Data from SITES 2006 were analysed using the exploratory factor analysis method and six factors for measuring conditions for ICT use were identified (Yuen et al., 2008, p. 4). Subsequently the authors tested for correlations between the factors – the results of which were tabulated in a pair-wise correlation matrix (p. 7). The correlation matrix revealed that all the factors contribute significantly positively to learners' 21st Century Skills, except for the teacher-related factors, which can in fact create a barrier (p. 7).

Based on the correlations a model was developed to see how the above-mentioned factors affect learners' 21st Century Skills (Yuen et al., 2008, p. 5). The hypothesised model was tested by testing the 'direct and indirect effects of each factor' (p. 8). The results validated the hypothesised model and indicated significant relationships at school level, competence level and between orientation and perception (p. 8), with teacher perception being the strongest predictor of learners' 21st Century Skills (p. 9).

2.4.4 ICT supported pedagogical policies and practices in South Africa and Chile: emerging economies and realities

Using data from SITES 2006, Howie's (2010) qualitative study reports on approaches to ICT policies in South Africa and Chile. The aim was to compare policies of ICT implementation in these two developing countries that share some characteristics. However, these countries display marked differences in the success of their ICT implementation efforts in education.

It has been mentioned that Chilean schools wanting to integrate ICT have to submit a detailed proposal for ICT implementation – taking ownership of the implementation process (Howie, 2010, p. 520). In South Africa, however, schools receive ICT equipment irrespective of whether they have applied for it or not (p. 520).

The research report brings to light an evident gap in the literature – the implementation of ICT in education – as research focuses mostly on policy and policy intentions (Howie, 2010, p. 521). Yet, for the purpose of this report, no secondary data analysis was conducted and not much attention was given to ICT implementation practices.

2.5 21st Century Skills

For learners to be successful in work and life in the modern economy, 21st Century Skills Development need to be integrated into our education system. As Trilling and Fadel (2009,

pp. 10-11) remark, the most important abilities for today's job requirements are an "ability to quickly acquire and apply new knowledge" and being able to "apply essential 21st century skills …".

These abilities are not only important for so-called "high-growth, technology-driven" STEM[15] occupations, but in all fields of work and everyday life, especially where the goal at hand is to add value of any kind, whether it is through service delivery or the production of products.

With information technologies ever developing, information (be it text, audio or visuals) can be shared globally in an instant, using user-friendly devices, many of which can be used anywhere, at any time. It has changed the way we collect, process and utilise information – we find ourselves in the so-called *Knowledge Age* (Trilling & Hood, 1999; Kostos, 2006; Trilling & Fadel, 2009).

The influence and integration of technological development in modern economies are evident in everyday life – transportation, communication, work and many forms of recreation. Therefore technology needs to play a more prominent role in education. Through education, learners can learn to use technology responsibly with efficiency. Furthermore, quoting Trilling and Fadel (2009, p. 12):

> *Education plays four universal roles in society's evolving stage. It empowers us to contribute to work and society, exercise and develop our personal talents, fulfil our civic responsibilities, and carry our traditions and values forward.*

Using ICT in school gives learners the chance "to learn how to operate in an information age" (Bingimlas, 2009, p. 235). This is why there is a need to integrate the learning of 21st Century Skills into our education systems.

[15] Science, Technology, Engineering and Mathematics

2.6 Obstructions and other influencing factors to ICT implementation

This section focuses of obstructions and other factors that can influence the implementation of ICT in schools.

2.6.1 ICT in Hebrew-speaking and Arabic-speaking schools in Israel: findings from SITES 2006

Having analysed categorical data, the qualitative research conducted by Baruch, Nachmias and Mioduser (2010) aimed at investigating the difference in ICT perceptions and implementation thereof in Arabic and Hebrew schools in Israel (p. 4). According to the authors, the findings from SITES 2006 clearly indicate unequal access to computers in Arabic and Hebrew schools – where there is approximately one computer for every 21 learners in Arabic schools; Hebrew schools can provide one computer for every 11.1 learners (p. 2).

This secondary data analysis utilised the SITES 2006 Israeli data provided by 380 school principal questionnaires, 380 ICT coordinator questionnaires[16] and 2 038 Grade 8 Mathematics and Science teacher questionnaires (Baruch et al., 2010, p. 3). The methods of data analysis were not discussed. However, the research paper reported on principals' views on the importance of ICT use and on priorities regarding infrastructure and encouragement of teachers to acquire ICT skills and knowledge (Baruch et al., 2010).

For each of the questionnaire items analysed, the number of participants, average rating of each questionnaire item together with its standard deviation, effect size (r) and significance level are given (Baruch et al., 2010, p. 12-14). Results from the teacher questionnaires include the numbers and percentages for ICT implementation in the classroom and obstacles

[16] The ICT Coordinator Questionnaire was mentioned in the article; however, no results of any analyses conducted, using the data gathered by means of this questionnaire, were included in the article.

encountered (p. 14-16). All the results have been tabulated for easy comparison and interpretation (p. 12-16).

As mentioned before Baruch et al. (2010, p. 12) reported on the importance of ICT use according to the principals' views. The questionnaire items found to be statistically significant are the following:

- "To foster collaborative and organizational skills when working in teams"
- "To satisfy parents' and the community's [sic] expectations"
- "To act as a catalyst in changing the pedagogical approaches of teachers"

Referring specifically to the second item, the authors point out traditional characteristics of the Arabic sector to be of great importance (Baruch et al., 2010, p. 5). They also mention that overall it seems that principals regard ICT use to be more important than do principals from the Hebrew sector (pp. 4-5).

Also noteworthy are obstacles encountered by Mathematics and Science teachers when wanting to implement ICT in their classrooms. The results for each questionnaire items are reported by means of percentages (Baruch et al., 2010, pp. 15-16), as mentioned before. Teachers from the Arabic sector reported facing more difficulties than teachers from the Hebrew sector (pp. 15-16).

For both Mathematics and Science teachers from the Hebrew sector, a lack of digital resources and time-constraints seem to be the biggest obstacles (Baruch et al., 2010, pp. 15-16). Teachers from the Arabic sector in both subjects report a lack of ICT infrastructure, lack of digital learning resources and a lack of ICT skills in learners as the most significant obstacles (pp. 15-16). In addition to these obstacles, Arabic Mathematics teachers also report ICT not being considered useful in their schools and their learners not having access to ICT tools outside the school.

2.6.2 Influences on the implementation of ICT teaching in Australia

Ainley (2010) studied SITES 2006 data gathered from 1 100 teachers in 301 Australian schools. The aim was to investigate factors that can influence the regularity of ICT use in Australian schools and then to compare the influences of these factors in other countries. The differences in ICT use were then interpreted in relation to national and state level policy initiatives.

Ainley (2010) used three methods to analyse the data for this secondary analysis of SITES 2006 data. Firstly, the Australian national data were compared, reporting on sample size, percentages and means in Australia and other countries. Secondly, logistic regression was used to analyse the SITES 2006 data to explore teacher-level factors that influence ICT use in Mathematics and Science classrooms. Thirdly, school-level and teacher-level influences on ICT use were investigated by means of multi-level logistical regression.

The results revealed percentages of Mathematics and Science teachers teaching year eight who apply ICT in their teaching (Ainley, 2010, p. 3):

- Of all the education systems compared, Australia rated the highest for Science teaching, followed by Singapore and Hong Kong, with South Africa ending last.
- For Mathematics teaching, Norway rated the highest, followed by Denmark, Australia in sixth position and South Africa last again.

Ainley (2010) also calculated the means for teachers' perceived confidence in ICT use for Mathematics and Science (p. 5), as well as participation in professional development (p. 6). Computer-to-student ratios were expressed by means of averages calculated for each education system (p. 8). Furthermore, factors associated with ICT use were analysed by means of a logistic regression analysis (p. 8). It was assumed that there would be more than one determinant of ICT use by teachers and so multivariate techniques were applied (p. 8). It was found that the following determinants showed statistical association to ICT use (pp. 9-10):

- Subject (Mathematics or Science)
- Teacher competence/confidence (which showed to have the strongest effect)
- Participation in professional development (which proved to have the weakest effect)
- Obstacles (school-level obstacles to ICT use reported by teachers)

Applying multi-level logistical regression, Ainley (2010, pp. 11-12) investigated the school-level factors (computer-to-student ratio and available hours of IT support) associated with teacher-level factors (subject, competence and professional development). The output of the analysis revealed regression coefficients, standard errors, significance values and odds ratios, which were tabulated and discussed. Ending the research article, an interpretation was given in terms of policies and practices (pp. 12-14).

2.6.3 ICT in education policy and practice in Chile: does it correlate?

In addressing the research question, "To what extent are national ICT-related policies implemented at school and classroom levels and what factors enable this implementation?", Hinostroza and Brun (2010) conducted linear correlation analyses on SITES 2006 data. The following three points were investigated (p. 1):

- The main SITES 2006 results of the investigation into traditional and innovative educational practices (with and without ICT) in Chile
- The effect of certain factors on the implementation of these practices
- The extent to which Enlaces (ICT education policy in Chile) has contributed to the Chilean SITES 2006 results

To this end, Hinostroza and Brun (2010, p. 5) analysed data collected from a sample of 711 Mathematics teachers, 692 Science teachers and 596 principals and schools' ICT coordinators. School and teacher factors that influence traditional and innovative educational practices were then derived from this sample (p. 5). The graphed results indicated a positive relationship between the frequency of ICT use and innovative

educational practices (p. 6). Even though the results indicated that the correlations are lower compared to the international data, the authors suggest that the overall positive results can be linked to the achievements of Enlaces.

2.6.4 Context factors associated with ICT use by Mathematics teachers

Aiming to find out to what extent and on which characteristics relatively high (HIMA) versus relatively low (LOMA) ICT using countries differ, Pelgrum (2008, p. 2) explored possible causes of stagnating ICT integration. By taking on an explorative approach, questionnaire items from the SITES Principal Questionnaire were analysed (p. 3). The author explains that this approach was taken instead of creating composites of questionnaire items, because it allows hidden phenomena within items – which would otherwise be overlooked – to be observed (p. 3).

Pelgrum (2008, p. 4) calculated effect sizes between the two groups of countries, making the cut-off values for meaningful effect sizes larger than 0.5 and lower than -0.5. Then, the profiles of countries were compared based on school context factors – factors that can potentially bring about educational change (p. 4). The results of the analysis indicate that there were 53 items with effect sizes higher than 0.5 and through factor analysis, five factors for interpretation were identified (p. 8). They were the following:

- Active communication
- Priorities for school leadership development
- Assessment orientation
- ICT use of school leader (for communication and administration)
- Bottom-up change orientation

The factor scores that were generated were then used to compare the country profiles between HIMA and LOMA countries as well as countries that are culturally comparable (Pelgrum, 2008, p. 9). One finding was that HIMA and LOMA countries' schools experienced similar obstacles to accomplishing pedagogical goals, except for the lack of computers with

Internet connection that was reported more often in HIMA countries (p. 7). The outcome of the profile analysis has implications for policy-making, as suggested by the author (p. 9).

2.6.5 School and teacher factors associated with frequency of ICT use by Mathematics teachers: country comparisons

Using SITES 2006 data collected from schools where Mathematics is taught, Pelgrum and Voogt (2009) investigated factors at school and at teacher level that are associated with the frequency of ICT use. The study endeavoured to determine how "HIMA countries differ from LOMA countries with respect to characteristics of the change (pedagogical approach and lifelong learning competencies) as well as teacher and school factors affecting the implementation of ICT …".

As with Pelgrum (2008), Pelgrum and Voogt (2009, p. 298) compared HIMA and LOMA countries by calculating effect sizes. The items with an effect size between -0.5 and 0.5 were then analysed using factor analysis to produce these five factors for interpretation: active communication, school leadership development, assessment orientation, ICT use by school leaders and bottom-up change orientation (p. 293). These factors can be utilised for policy awareness (p. 306) and for educational change-implementation (p. 302).

2.6.6 How different are ICT-supported pedagogical practices from extensive and non-extensive ICT-using Science teachers?

Attempting to understand the different characteristics of extensive and non-extensive ICT-using Science teachers' ICT-supported pedagogical practices, the research on new (innovative) and traditional pedagogical practices by Voogt (2009) was centred on these research questions (p. 328):

- "How do Science teachers characterize satisfying ICT-supported pedagogical practices with respect to student outcomes, teaching practices, and distribution of responsibility for aspects of teaching and learning?"
- "How do regular pedagogical practices differ between teachers who use ICT extensively with teachers who do not use ICT extensively?"

Using data from SITES 2006, Voogt (2009) reported the percentages of teachers using ICT either once a week, extensively during a limited period in the school year, less extensively or not at all. Teachers using ICT more extensively had to describe satisfying ICT pedagogical practices (p. 329).

The descriptions were then used to create more specific close-ended questions for the teachers to answer, pertaining to the following*: The contribution of ICT on changes in student outcomes*, *changes in their teaching practice* and *the main initiating actor (teacher/student) of teaching/learning* (Voogt, 2009, p. 329). It was concluded that traditional pedagogical practices are still dominant in both groups of Science teachers' classrooms (p. 341).

2.6.7 Teacher factors associated with innovative curriculum goals and pedagogical practices: differences between extensive and non-extensive ICT-using Science teachers

Focusing on the indicators *pedagogical orientation*, *ICT competencies* and *professional engagement*, Voogt (2010) conducted a secondary data analysis, using SITES 2006 data, to study differences between extensive and non-extensive ICT-using Science teachers. Variables in the Teacher Questionnaire were grouped according to themes, which were analysed and then organised to create the aforementioned indicators (p. 457) in terms of which the findings were discussed (pp. 458-461).

To analyse the data, alpha values (α) were calculated (Voogt, 2010, p. 457). Furthermore, to investigate the difference between extensive and non-extensive ICT-using teachers, means

and standard deviations were calculated and *t*-tests were conducted (p. 458). Lastly, effect sizes were calculated for each item. It was found that there exists a positive relationship between how often ICT is used and innovative pedagogical orientation, as well as the frequency of ICT use and professional engagement (pp. 461-462).

The main findings showed that extensive ICT-using Science teachers tend to pursue innovative educational goals and practices (Voogt, 2010, p. 454). They were also found to be more confident ICT-users and professionally engaged, though both groups' pedagogical orientations displayed traditional educational practices (p. 454).

2.7 Executive summary of the literature review

Table 2.1 presents an executive summary of the literature that has been reviewed in this chapter.

Table 2.1: Executive summary

Theme	Findings/Noteworthy remarks	Reference
Secondary data analysis	Understanding the context of the original research effort is one of the difficulties of secondary analysis.	Blaxter (2007)
	When using secondary data, the researcher is not able to control data collection errors.	Mouton (2001)
	Conducting a secondary analysis can help the researcher avoid unnecessarily burdening research participants.	Heaton (1998); Kelder (2005)
	Conducting a secondary analysis can also save time and money.	Mouton (2001); Kelder (2005)

Table 2.1: Executive summary (continued)

Theme	Findings/Noteworthy remarks	Reference
SITES 2006	ICT is used 9% to 18% of the time by South African Mathematics and Science teachers for various activities.	Blignaut et al. (2010)
	62% of South African schools lack computers. Most of the schools with computers still lack Internet access.	Howie and Blignaut (2009)
	Teacher perception is the strongest predictor of learners' 21st century skills.	Yuen et al. (2008)
21st Century Skills	The most important abilities for today's job requirements are an "ability to quickly acquire and apply new knowledge" and being able to "apply essential 21st Century Skills …".	Trilling and Fadel (2009)
Influencing factors on ICT implementation	Teachers from the Hebrew sector viewed a lack of digital resources and time-constraints as the biggest obstacles. Teachers from the Arabic sector reported a lack of ICT infrastructure, lack of digital learning resources and a lack of ICT skills in learners as the most significant obstacles. Arabic Mathematics teachers also reported ICT not being considered useful in their schools and their learners not having access to ICT tools outside the school.	Baruch et al. (2010)

Table 2.1: Executive summary (continued)

Theme	Findings/Noteworthy remarks	Reference
Influencing factors on ICT implementation (continued)	A lack of computers with Internet connection was reported more often in HIMA countries.	Pelgrum (2008)
	Traditional pedagogical practices are still dominant in Science teachers' classrooms, both where ICT is used extensively, as well as where it is used less often.	Voogt (2009)
	Extensive ICT-using Science teachers tend to pursue innovative educational goals and practices. They were also found to be more confident ICT-users and professionally engaged. Both groups' pedagogical orientations displayed traditional educational practices.	Voogt (2010)

2.8 Conclusion

Based on the literature as summarised in Table 2.1, conducting a Secondary Data Analysis holds both advantages and disadvantages for the researcher – where time and money can be saved, the researcher cannot control data collection errors and has to take issues into account such as the research questions and ethics. Regarding factors influencing ICT use, underdeveloped infrastructure and a lack of resources seem to be persistent obstructions generally; teachers seem to hold on to traditional pedagogical practices, as summarised in Table 2.1.

Chapter 3

Research design and methods

3.1 Introduction

In this chapter the research design and methods are discussed. The first section summarises the data collection process and methods used for SITES 2006, since the data used for the current study were drawn from SITES 2006 dataset. The second section explains the research design and methods that were employed for the current study. The next chapter contains a description of the application of the design and methods, i.e. data gathering and analysis.

3.2 SITES 2006 research design and methods

Following COMPED (IEA Computers in Education Study 1989 and 1992), SITES Module 1 and SITES Module 2, the purpose of SITES 2006 was to encourage secondary data analysis (Brese & Carstens, 2009, pp. 7-8). To this end the SITES 2006 international database was made available to researchers, analysts and the general public, together with a User Guide (Brese & Carstens, 2009). The research design and methods employed for SITES 2006 are discussed in section 3.2.1 – 3.2.4.

3.2.1 Sampling and data collection

The IEA gathered information from about 13 000 Mathematics teachers and more than 16 000 Science teachers from about 8 000 schools in 22 countries (with Australia acting as a benchmarking country) for the SITES 2006 project (Brese & Carstens, 2009, p. 8). The aim of

the project was to see which pedagogical practices are applied in various education systems and how ICT is used (p. 8).

Data were collected from 22 education systems (Australia acting as a benchmark) where Mathematics and Science are offered to learners in their eighth school year (Brese & Carstens, 2009, p. 10). Schools received three different questionnaires – one questionnaire for principals, one Technical Questionnaire (for ICT coordinators) and one Teacher Questionnaire for both Mathematics and Science teachers (Brese & Carstens, 2009, p. 10). The sample size for the Principals' questionnaire of the original study consisted of 500 school principals (Carstens & Pelgrum, 2009, p. 161). However, only 451 of the cases were valid and included in the current study. Brese and Carstens (2009) describe the sampling procedure applied in the SITES 2006 study:

- A two-stage stratified cluster sampling procedure was used.
- School samples were drawn based on school size during the first stage and during the second stage. Using IEA DPC software, random samples were drawn.

Blignaut, Els and Howie (2010, p. 561) reported that the South African National Centre trained Master's students in quantitative research and research fieldwork, who then participated in the SITES 2006 data collection stage in South Africa. Participating schools were allocated to the students according to where the students were living or working (p. 561) and the fieldwork was conducted accordingly.

3.2.2 Data analysis

IEA International Database (IDB) analyser software[17] was used to analyse the international data files (Gonzales & Hencke, 2009, p. 29). The authors explain that the IEA IDB Analyser software was developed by the IEA Data Processing and Research Centre (IEA DPC) and operates in conjunction with the Statistical Package for the Social Sciences (SPSS). Coupled with SPSS, the data files from the different education systems were combined and then

[17] The software is available from http://www.iea.nl

analysed. The data files can be processed using either the analysis module of the IEA or SPSS (p. 30).

3.2.3 Quality control

The IEA applied rigorous measures for quality control to ensure high quality data collection and processing (Carstens & Pelgrum, 2009, p. 75). Amongst the measures taken, each national centre ran standardised checks on their own data to identify any inconsistencies, duplications and reliability problems in data entries (Brese & Carstens, 2009, p. 11). Furthermore quality was assured through application of about 135 different structural, validity and consistency checks (p. 11).

Carstens and Pelgrum (2009, p. 75) explain that the centres were provided with WinDem software (Windows Data Entry Manager software) and the *SITES 2006 Data Management Manual*, published by the IEA DPC (2006). The authors state that the intermediaries between the national centres and the IEA DPC (who also oversaw data management), attended a four-day seminar to learn how to use the software and familiarise themselves with the procedures and rules (p. 75).

3.2.4 Reliability

Reliability was guaranteed by having each national centre enter a number of questionnaires twice: about 40 each of the principal and technical questionnaires and about 100 teacher questionnaires (Carstens & Pelgrum, 2009, p. 76). After the IEA DCP received the data, it was cleaned so that "… the data adhered to international formats … and that the data accurately and consistently reflected the information collected within each education system" (p. 77).

It is worth mentioning that South Africa was the only country that completed the surveys using a paper-and-pencil method according to Blignaut, Els and Howie (2010, p. 555), as opposed to completing the surveys online. Brečko and Carstens (2007, p. 265) found that

the reliability of the two data collection methods are comparable. However, there were more missing items in the online surveys (p. 269). The drop-out rate was found to be higher for the online surveys (pp. 266-267). South Africa was commended for its level of data integrity (Blignaut, Els & Howie, 2010, p. 559).

3.3 Research design and methods for the current study

A secondary data analysis was conducted, drawing on the ZAR data from the international database for the SITES 2006 project. Data gathered from a sample of 451 school principals were analysed. The descriptive analysis included frequencies from data gathered for SITES 2006 on (1) gender distribution of the principals and teachers[18]; (2) principals' age distribution; (3) information on principals' personal computer use; (4) computer access at home and (5) what the principals use their home computers for.

For the inferential analysis five indicators were chosen from the SITES 2006 Principal Questionnaire[19] (three of which served as layer variables). From these altogether fifteen items were identified as the variables to be used for the inferential analysis. Two variables were correlated at a time – one dependent variable from Question 3 (see Addendum A) and one independent variable from Question 16 (Addendum A). The items chosen from Question 3 are the following:

- To prepare learners for the world of work
- To promote active learning strategies
- To foster collaborative and organisational skills when working in groups
- To develop learners' independence and responsibility for their own learning

The items chosen from Question 16 are the following:

- Insufficient qualified technical personnel to support the use of ICT

[18] From the Teacher Questionnaire (Brese & Carstens, 2009, p. 105)
[19] Brese & Carstens (2009, p. 67)

- Insufficient ICT equipment for instruction
- Computers are out of date.
- Not enough digital educational resources for instruction
- Teachers' lack of ICT skills

The layer variables, chosen from the same questionnaire, are (1) gender (male/female); (2) whether the subjects have home computers (yes/no); (3) if so, what do they use them for (school-related activities/connecting to the Internet). Each combination of dependent and independent variables was then analysed with one of the layer variables at a time, to see for example, what the nature of the correlation is between the goal *to prepare learners for the world of work* and the obstruction *lack of digital educational resources*, in both the case of male and female principals.

By calculating the strength and direction of correlations between the variables, the study attempted to discover what the relationship is between the importance of use for 21st Century Skills Development and factors influencing ICT implementation. This relationship was also investigated for the aforementioned sub-groups (for example either male, or female principals).

The data were analysed in SPSS, using Spearman's rho analysis. Spearman's rho is a non-parametric test that calculates the strength and direction of the relationship between variables measured on an ordinal scale. The variables have a monotonic relationship, that is, the more one variable increases, the more the other will decrease. In other words, the stronger the obstructions to ICT implementation, the less likely it is that South African schools are ready to implement ICT. The research design is summarised in Table 3.1.

Table 3.1: Research design

Research question	Research paradigm	Data collection	Data analysis	Sample
What is the relationship between the importance of ICT use for 21st Century Skills Development and obstructions hindering ICT goals in the light of currently available *Infrastructure* in S.A. schools?	Integrated quantitative and qualitative design	SITES 2006 Principal Questionnaire data for South Africa	Spearman's rho correlation using SPSS to calculate the relationship between the dependent and independent variables	451 school principals
What is the relationship between the importance of ICT use for 21st Century Skills Development and obstructions hindering ICT goals in the light of currently available *Human Resources* in S.A. schools?	Integrated quantitative and qualitative design	SITES 2006 Principal Questionnaire data for South Africa	Spearman's rho correlation using SPSS to calculate the relationship between the dependent and independent variables	451 school principals

The chapters to follow will explain how the research design, as summarised in Table 3.1, was applied.

Chapter 4

Data gathering and analysis

4.1 Introduction

Chapter 4 focuses on the processes of data gathering, analysis and the representation of the results. In section 4.2 an explanation of how the data were captured is given, followed by a description of the data by means of descriptive analysis in section 4.3, which includes frequencies in percentages and the number of missing cases for each of the variables. Section 4.4 presents the data analysis conducted for the purpose of answering the research questions. Section 4.5 concludes this chapter.

4.2 Data capturing

The data for SITES 2006 are freely available on the Internet for secondary data analysis. For the purpose of the current research project the original participants were not needed to be contacted and their anonymity was guaranteed as per the original study. Guidelines in the User Guide[20], provided by the IEA, were studied to ensure appropriate analysis of the data. Written permission to use the data was obtained from the South African National Centre for SITES 2006 (see Addendum B). This was done after ethical clearance had been granted by the Ethics Committee of the University of Pretoria.

The data were extracted from the IEA Data Repository[21]. For the inferential analysis two questions from the SITES 2006 Principal Questionnaire (see Addendum A) were selected. These two questions were chosen based on linguistic coherence between the variables; for

[20] Brese & Carstens (2009, p. 67)
[21] http://rms.iea-dpc.org/#

example, *to prepare students for future work* (Addendum A, dependent variable) could be influenced by *insufficient ICT equipment for instruction* (Addendum A, independent variable). The data, collected through these two questions from school principals in South Africa, were then analysed. The two questions focus on (1) the importance of ICT use for 21st Century Skills Development and (2) ICT-related obstacles.

4.3 Descriptive analysis

This study focuses on principals' views on the importance of ICT goals for 21st Century Skills Development. Since the importance attached to certain goals could be influenced by characteristics of the principals, a descriptive analysis is presented in order to illustrate these characteristics. As mentioned before (See section 3.3) the characteristics that were included for descriptive analysis are: (1) gender; (2) age; (3) personal computer use; (4) computer access at home and (5) computer use at home (school-related activities and Internet).

4.3.1 Gender distribution

An interesting personal characteristic to look at would be gender. Figure 4.1 illustrates the gender distribution in percentages for male and female principals and teachers who participated in SITES 2006, both in South Africa and internationally.

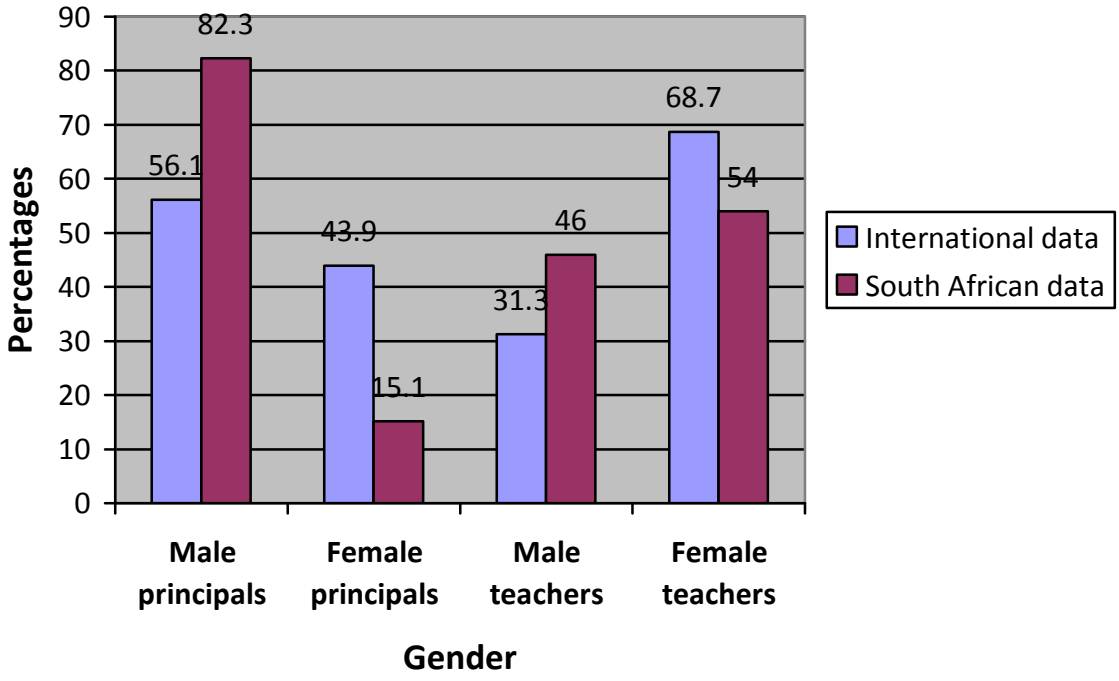

Figure 4.1: Gender distribution

From the South African participants who answered the question, the majority of principals are male (82.3%[22]) and a mere 15.1% are female. Less than 3% of the participants did not indicate their gender. Internationally, a similar pattern was found in that there are more male than female principals, though the ratio was much more even – 56.1% male compared to fewer female principals (43.9%). Of all the South African teachers who answered this question, there were more females (54%) and fewer male teachers (46%). Looking at the international data, there are also more female teachers; 68.7 % and 31.3% of the teachers who answered the question are male.

4.3.2 Age distribution

Figure 4.2 illustrates the age distribution in percentages for South African principals who participated in the SITES 2006 study.

[22] South African language practices prescribe the use of the decimal comma. However, to conform to APA standards, the decimal point is used throughout the text.

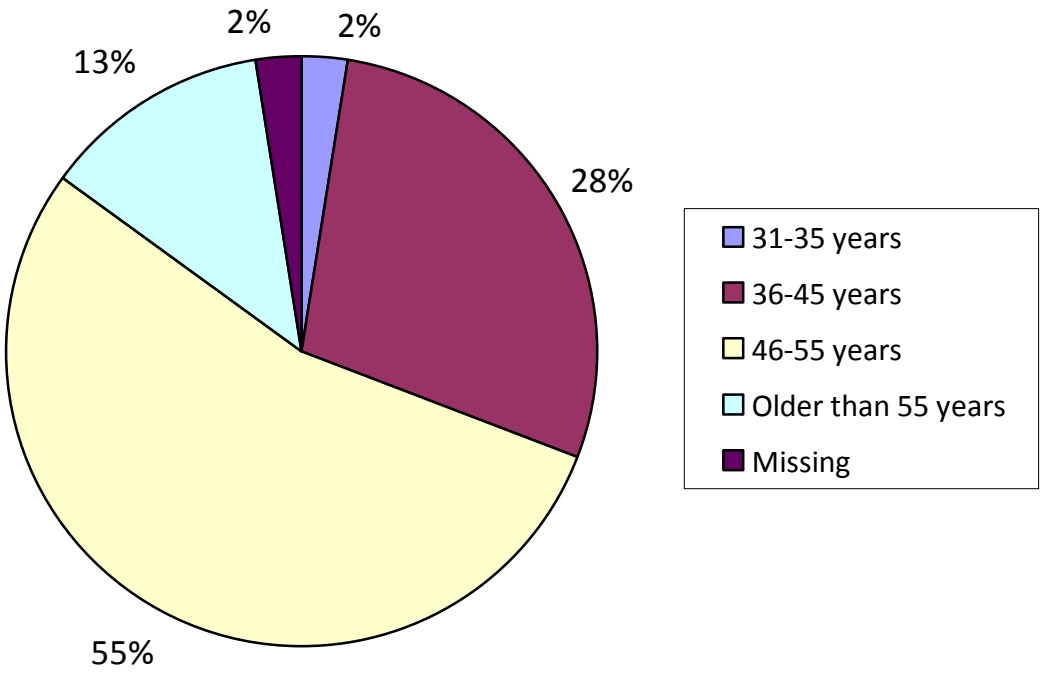

Figure 4.2: Age distribution

Figure 4.2 reveals that the majority of South African principals (55%) that took part in the study are between 46 to 55 years of age. The second largest age group, at 28%, is between the ages 36 to 45. The eldest group, being more than 55 years of age, consists of 13% of the respondents and only 2% of the respondents were aged between 31 to 35 years.

4.3.3 Personal computer use

In an investigation of what it is that principals view as important ICT activities in their schools, it would be interesting to look at how often they employ computers for personal use. Figure 4.3 illustrates in percentages how often the South African principals make use of computers.

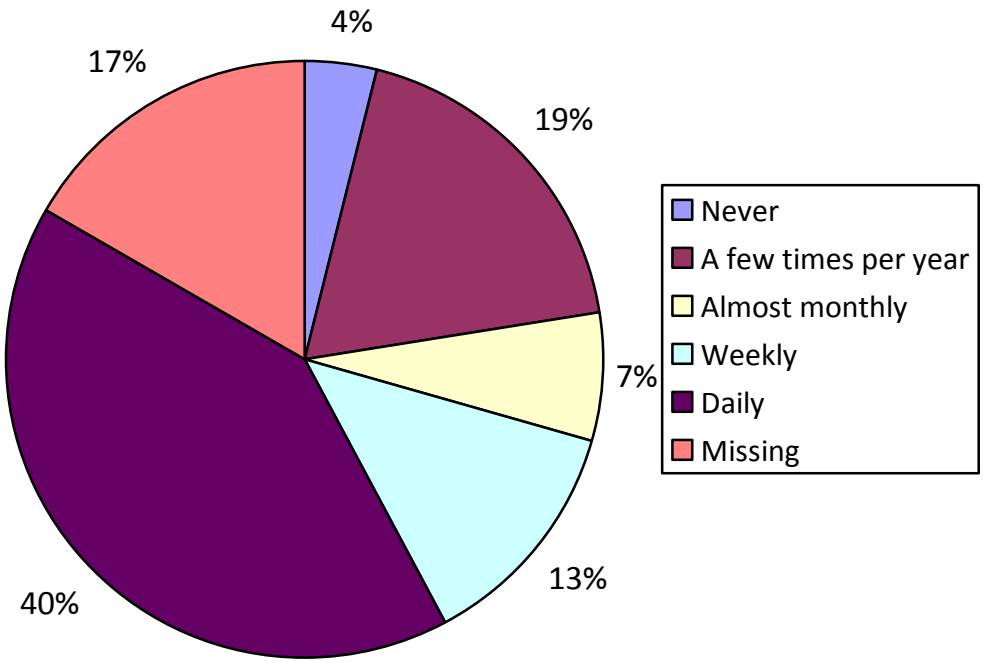

Figure 4.3: Personal computer use

Only about 40% of the participants indicated that they use computers on a daily basis. Furthermore, 13% of the principals use computers weekly and 19% use computers only a few times per year. A mere 4% were found not to use computers at all. A considerable amount of participants (17%) left this question blank.

4.3.4 Computer access at home

A closer look was taken at the personal computer use of South African principals. In Figure 4.4 it can be observed that 83.4% have home computers, as opposed to 7.3% who do not.

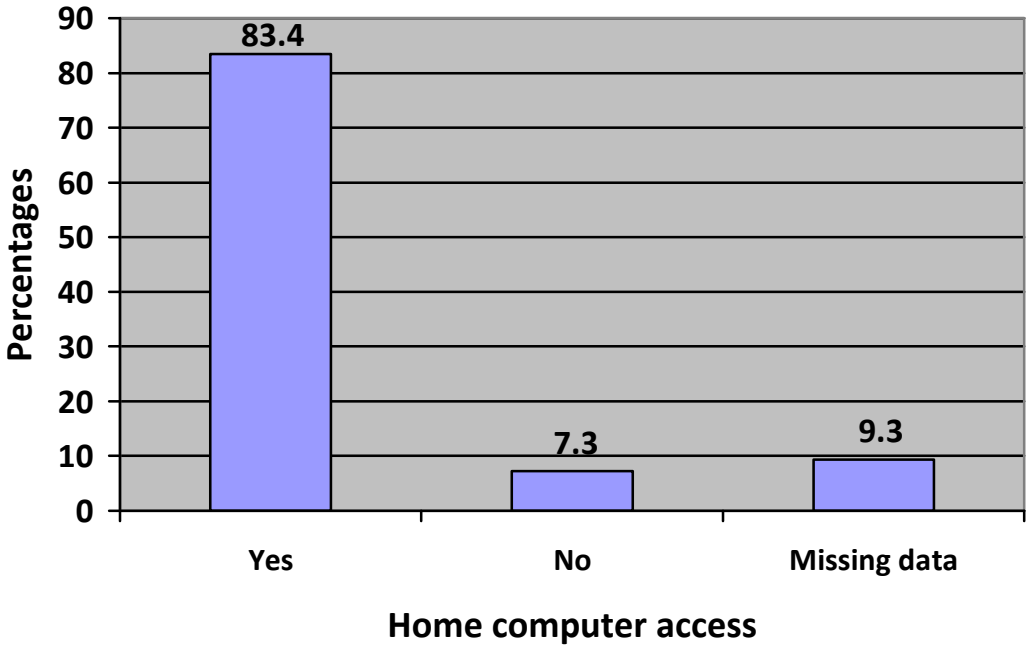

Figure 4.4: Home computer access

Further investigation has revealed how principals use their home computers. From the participating principals, 64.1% indicated that they use their computers at home for school-related activities, whereas 21.3% said that they do not, as seen in Figure 4.5.

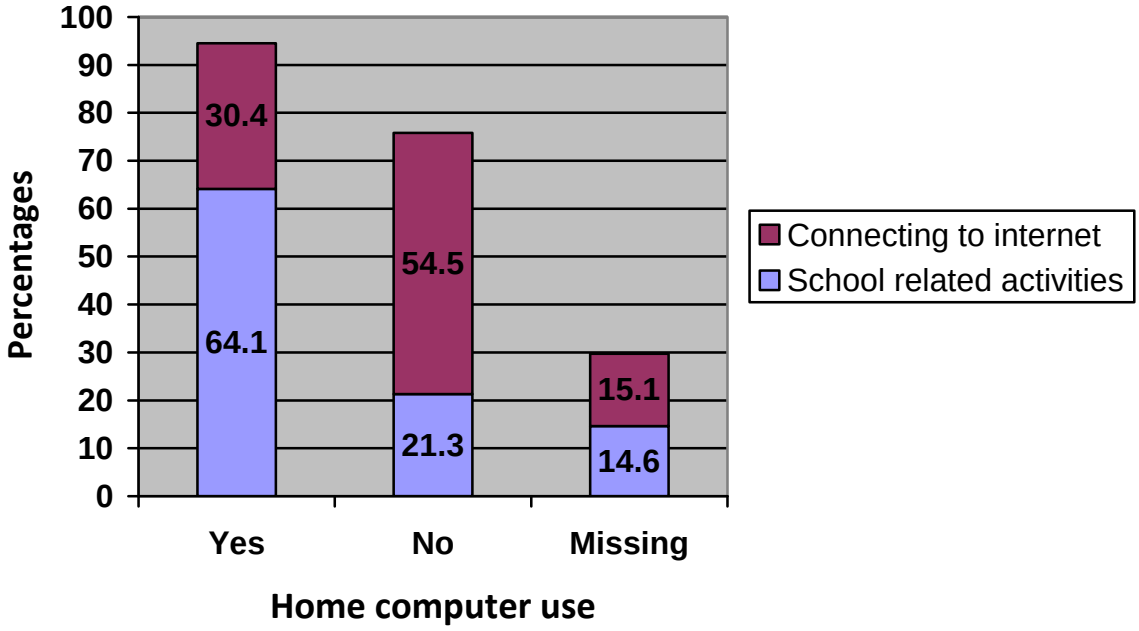

Figure 4.5: Home computer use

Principals were also asked if they use their home computers to connect to the Internet. It was found that more than half (54%) do not use their computers at home to connect to the Internet, as opposed to 30.4% who answered this question in the affirmative.

4.4 Inferential analysis

The output for the inferential analysis is presented in this section. The results have been tabulated, giving the Spearman's rho correlation (r_s) to present the relationship between the items and the significance level (p) to indicate the strength of the significance. The variables that correlated at the 0.01 and 0.05 levels were deemed significant and are discussed in the following chapter. Table 4.1 presents the organisation of the results section.

Table 4.1: Organisation of results section

Goal	Obstruction	Section
To prepare learners for future work	Insufficient qualified technical personnel to support ICT use	**4.4.1**
	Insufficient ICT equipment for instruction	
	Computers are outdated	
	Insufficient digital educational resources for instruction	
	Teachers' lack of ICT skills	
To promote active learning strategies	Insufficient qualified technical personnel to support ICT use	**4.4.2**
	Insufficient ICT equipment for instruction	
	Computers are outdated	
	Insufficient digital educational resources for instruction	
	Teachers' lack of ICT skills	
To practise collaborative and organisational skills through teamwork	Insufficient qualified technical personnel to support ICT use	**4.4.3**
	Insufficient ICT equipment for instruction	
	Computers are outdated	
	Insufficient digital educational resources for instruction	
	Teachers' lack of ICT skills	
To develop learners' independence and responsibility for their own learning	Insufficient qualified technical personnel to support ICT use	**4.4.4**
	Insufficient ICT equipment for instruction	
	Computers are outdated	
	Insufficient digital educational resources for instruction	
	Teachers' lack of ICT skills	

4.4.1 To prepare learners for future work

Spearman's correlation coefficient was calculated to determine the relationship between the ICT goal for 21st Century Skills Development, *to preparing learners for future work* and the obstruction of having *insufficient qualified technical staff that is able to support ICT use*. The results are tabulated in Table 4.2.

Table 4.2: To prepare for future work/Insufficient qualified technical personnel

Item		r_s
Insufficient qualified technical staff that is able to support ICT use		r_s (416) = -.185, p < .01
Gender	Male	r_s (348) = -.176, p < .01
	Female	r_s (63) = -.195, p = .125
Home computer access	No	r_s (28) = -.097, p = .622
	Yes	r_s (357) = -.2, p < .01
Home computer use	School-related activities	r_s (277) = -.115, p = .056
	Connecting to the Internet	r_s (133) = -.189, p < .05

In general a negative, very weak, yet significant relationship was found between having insufficient qualified technical personnel and preparing learners for future work r_s (416) = -.185, p < .01. This also held true for male principals, r_s (348) = -.176, p < .01 and principals who use their home computers to connect to the Internet, r_s (133) = -.189, p < .05. However, a weak, negative, yet significant correlation was found in the case of all the principals who have access to computers at home.

Spearman's correlation coefficient was calculated to determine the relationship between the ICT goal *preparing learners for future work* and the obstruction *insufficient ICT equipment for instruction*, tabulated in Table 4.3.

Table 4.3: To prepare for future work/Insufficient ICT equipment for instruction

Item		r_s
Insufficient ICT equipment for instruction		r_s (415) = -.155, p < .01
Gender	Male	r_s (347) = -.157, p < .01
	Female	r_s (63) = -.104, p = .417
Home computer access	No	r_s (27) = -.156, p = .436
	Yes	r_s (357) = -.147, p < .01
Home computer use	School-related activities	r_s (277) = -.009, p = .878
	Connecting to the Internet	r_s (132) = -.238, p < .01

Generally a very weak, negative correlation was found, r_s (415) = -.155, p < .01. A very weak, negative correlation was discovered in the case of male principals, r_s (347) = -.157, p < .01 and principals who use their home computers to connect to the Internet, r_s (132) = -.238, p < .01. Also showing a very weak, negative correlation was all South African principals who have access to a computer at home.

Spearman's correlation coefficient was calculated to determine the relationship between the ICT goal *preparing learners for the world of work* and the obstruction of *computers being out of date*, tabulated in Table 4.4.

Table 4.4: To prepare for future work/Computers are outdated

Item		r_s
Computers are outdated		r_s (415) = -.169, p < .01
Gender	Male	r_s (347) = -.21, p < .01
	Female	r_s (63) = .033, p = .8

Table 4.4: To prepare for future work/Computers are outdated (continued)

Item		r_s
Home computer access	No	r_s (28) = -.207, p = .29
	Yes	r_s (355) = -.145, p < .01
Home computer use	School-related activities	r_s (274) = -.003, p = .962
	Connecting to the Internet	r_s (133) = -.201, p < .05

As seen in Table 4.4, in general there is a very weak, negative correlation between *computers being outdated* and *preparing learners for future work*, r_s (415) = -.169, p < .01. In the case of principals who have home computers, r_s (355) = -.145, p < .01 there is a weak, negative correlation. Furthermore, a weak correlation exists in the case of male principals, r_s (347) = -.21, p < .01, as well as principals using their home computers to connect to the Internet, r_s (133) = -.201, p < .05.

The relationship between the ICT goal *preparing learners for future work* and the obstruction *having insufficient digital educational resources* was computed by means of Spearman's rho calculation. *Not having enough digital educational resources* and *preparing learners for future work* displays a very weak, negative correlation, r_s (420) = -.175, p < .01. The results are found in Table 4.5.

Table 4.5: To prepare for future work/Insufficient digital educational resources

Item		r_s
Insufficient digital educational resources for instruction		r_s (420) = -.175, p < .01
Gender	Male	r_s (351) = -.18, p < .01
	Female	r_s (64) = -.110, p = .386

Table 4.5: To prepare for future work/Insufficient digital educational resources (continued)

Item		r_s
Home computer access	No	r_s (28) = -.116, p = .557
	Yes	r_s (360) = -.183, p < .01
Home computer use	School-related activities	r_s (279) = -.055, p = .359
	Connecting to the Internet	r_s (133) = -.232, p < .01

A very weak, negative correlation exists in the case of male principals, r_s (351) = -.18, p < .01 and principals who have computer access at home, r_s (360) = -.183, p < .01, though a weak, negative correlation was found with principals using a home computer to connect to the Internet, r_s (133) = -.232, p < .01.

Spearman's correlation coefficient was calculated to determine the relationship between the ICT goal *preparing learners for the world of work* and the obstruction *teachers' lack of ICT skills*. The results are seen in Table 4.6.

Table 4.6: To prepare for future work/Teachers' lack of ICT skills

Item		r_s
Teachers lack ICT skills		r_s (419) = -.153, p < .01
Gender	Male	r_s (350) = -.171, p < .01
	Female	r_s (64) = -.013, p = .92
Home computer access	No	r_s (28) = -.064, p = .746
	Yes	r_s (359) = -.147, p < .01
Home computer use	School-related activities	r_s (278) = -.038, p = .523
	Connecting to the Internet	r_s (132) = -.175, p < .05

In general the variable *teachers lacking ICT skills and preparing learners for future work* shows a very weak, negative correlation, r_s (419) = -.153, p < .01. A very weak, negative correlation is seen in the case of male principals, r_s (350) = -.171, p < .01, principals with computer access at home, r_s (359) = -.147, p < .01 and the principals who use their home computers to connect to the Internet, r_s (132) = -.175, p < .05.

4.4.2 To promote active learning strategies

Spearman's rho correlation coefficient was calculated to determine the strength and direction of the variables *to promote active learning strategies* and certain obstructions to ICT implementation. As illustrated in Table 4.7, there is a very weak, negative correlation between *promoting active learning strategies* and having *insufficient qualified technical personnel*, r_s (417) = -.190, p < .01 in general.

Table 4.7: To promote active learning/Insufficient qualified technical personnel

Item		r_s
Insufficient qualified technical staff that is able to support ICT use		r_s (417) = -.190, p < .01
Gender	Male	r_s (349) = -.174, p < .01
	Female	r_s (63) = -.212, p = .095
Home computer access	No	r_s (28) = -.087, p = .661
	Yes	r_s (358) = -.212, p < .01
Home computer use	School-related activities	r_s (279) = -.13, p < .05
	Connecting to the Internet	r_s (133) = -.165, p = .057

The correlation in the case of male principals is very weak and negative, r_s (349) = -.174, p < .01, though a weak, negative correlation is found in the case of principals who have access to a computer at home, r_s (358) = -.212, p < .01. Furthermore, for principals

who use their home computers for school-related activities the variables correlate significantly as well, though the correlation is very weak, r_s (279) = -.13, p < .05. The direction of this correlation is negative.

Spearman's rho correlation coefficient was calculated to determine the relationship between the variables to *promote active learning strategies* and having *insufficient ICT equipment for instruction* and a very weak, negative correlation was found, in general, r_s (416) = -.157, p < .01, as Table 4.8 illustrates.

Table 4.8: To promote active learning/Insufficient ICT equipment for instruction

Item		r_s
Insufficient ICT equipment for instruction		r_s (416) = -.157, p < .01
Gender	Male	r_s (348) = -.163, p < .01
	Female	r_s (63) = -.091, p = .476
Home computer access	No	r_s (27) = -.165, p = .411
	Yes	r_s (358) = -.162, p < .01
Home computer use	School-related activities	r_s (279) = -.043, p = .472
	Connecting to the Internet	r_s (132) = -.262, p < .01

In the case of male principals there was also a very weak, negative correlation, r_s (348) = -.163, p < .01. In addition, the correlations were very weak for principals who have home computer access – the direction of the correlation is negative. A weak, negative correlation was found with principals who use their home computers for Internet use, r_s (132) = -.262, p < .01.

In general, a very weak, negative correlation was discovered between promoting active learning strategies and computers being out of date. The results for the Spearman's rho calculations are illustrated in Table 4.9.

Table 4.9: To promote active learning/Computers are outdated

Item		r_s
Computers are outdated		r_s (416) = -.134, p < .01
Gender	Male	r_s (348) = -.172, p < .01
	Female	r_s (63) = .032, p = .806
Home computer access	No	r_s (28) = -.16, p = .417
	Yes	r_s (356) = -.122, p < .05
Home computer use	School-related activities	r_s (276) = -.013, p = .83
	Connecting to the Internet	r_s (133) = -.164, p = .059

It can be seen from Table 4.9 in the case of male principals, r_s (348) = -.172, p < .01 and principals who have access to home computers, r_s (356) = -.122, p < .05 there is a very weak, negative correlation.

Spearman's correlation coefficient was calculated to determine the relationship between *promoting active learning strategies and not having enough digital educational resources*. In general, a very weak, negative correlation, r_s (421) = -.159, p < .01 was found. This also held true in the case of male principals, r_s (352) = -.166, p < .01, as well as principals who have computers at home, r_s (361) = -.155, p < .01. This is illustrated in Table 4.10.

Table 4.10: To promote active learning/Insufficient digital educational resources

Item		r_s
Insufficient digital educational resources for instruction		r_s (421) = -.159, p < .01
Gender	Male	r_s (352) = -.166, p < .01
	Female	r_s (64) = -.086, p = .498

Table 4.10: To promote active learning/Insufficient digital educational resources (continued)

Item		r_s
Home computer access	No	r_s (28) = -.175, p = .372
	Yes	r_s (361) = -.155, p < .01
Home computer use	School-related activities	r_s (281) = -.041, p = .495
	Connecting to the Internet	r_s (133) = -.168, p = .054

Table 4.11 reveals that in general, Spearman's rho correlation coefficient displays a very weak, negative correlation found between *promoting active learning strategies* and *teachers lacking ICT skills*, r_s (420) = -.156, p < .01.

Table 4.11: To promote active learning /Teachers' lack of ICT skills

Item		r_s
Teachers' lack of ICT skills		r_s (420) = -.156, p < .01
Gender	Male	r_s (351) = -.171, p < .01
	Female	r_s (64) = -.054, p = .673
Home computer access	No	r_s (28) = .039, p = .843
	Yes	r_s (360) = -.172, p < .01
Home computer use	School-related activities	r_s (280) = -.044, p = .466
	Connecting to the Internet	r_s (132) = -.174, p < .05

A very weak, negative correlation is seen in the case of male principals, r_s (351) = -.171, p < .01, principals who have home computers, r_s (360) = -.172, p < .01 and principals who access the Internet at home via their home computers, r_s (132) = -.174, p < .05.

4.4.3 To practise collaborative and organisational skills through teamwork

Spearman's rho correlation coefficient was calculated to find the direction and the relationship between *practising collaborative and organisational skills when working in teams* and having *insufficient qualified technical staff that is able to support ICT use*. In general there was a very weak, negative correlation with, r_s (418) = -.167, p < .01, as illustrated in Table 4.12.

Table 4.12: Collaborative and organisational skills/Insufficient qualified technical personnel

Item		r_s
Insufficient qualified technical staff that is able to support ICT use		r_s (418) = -.167, p < .01
Gender	Male	r_s (350) = -.149, p < .01
	Female	r_s (63) = -.205, p = .106
Home computer access	No	r_s (28) = -.08, p = .685
	Yes	r_s (359) = -.193, p < .01
Home computer use	School-related activities	r_s (279) = -.089, p = .139
	Connecting to the Internet	r_s (133) = -.139, p = .111

This also held true in the case of male principals, r_s (350) = -.149, p < .01, as well as principals who have access to computers at home, r_s (359) = -.193, p < .01.

Spearman's rho calculation revealed a weak, negative correlation between collaborative and organisational skills and having insufficient ICT equipment; in general, r_s (417) = -.177, p < .01, as seen in Table 4.13.

Table 4.13: Collaborative and organisational skills/Insufficient ICT equipment for instruction

Item		r_s
Insufficient ICT equipment for instruction		r_s (417) = -.177, p < .01
Gender	Male	r_s (349) = -.18, p < .01
	Female	r_s (63) = -.125, p = .329
Home computer access	No	r_s (27) = -.15, p = .456
	Yes	r_s (359) = -.191, p < .01
Home computer use	School-related activities	r_s (279) = -.044, p = .468
	Connecting to the Internet	r_s (132) = -.245, p < .01

As seen in Table 4.13 a very weak, negative correlation was found in the case of male principals, r_s (349) = -.18, p < .01 and principals with home computers, r_s (359) = -.191, p < .01. However, a weak, negative correlation was found in the case of principals who use their home computers to connect to the Internet, r_s (132) = -.245, p < .01.

Spearman's correlation coefficient was calculated to determine the relationship between *collaborative and organisational skills* and *computers being out of date*. In general, as illustrated by Table 4.14, a very weak relationship exists between these two variables, r_s (417) = -.118, p < .05. The direction of the correlation is negative.

Table 4.14: Collaborative and organisational skills/Computers are outdated

Item		r_s
Computers are outdated		r_s (417) = -.118, p < .05
Gender	Male	r_s (349) = -.143, p < .01
	Female	r_s (63) = -.004, p = .973

Table 4.14: Collaborative and organisational skills/Computers are outdated (continued)

Item		r_s
Home computer access	No	r_s (28) = -.038, p = .849
	Yes	r_s (357) = -.11, p < .05
Home computer use	School-related activities	r_S (276) = .023, p = .698
	Connecting to the Internet	r_s (133) = -.099, p = .257

There was a very weak, negative correlation in the case of male principals, r_s (349) = -.143, p < .01 and principals with home computers, r_s (357) = -.11, p < .05.

Spearman's rho correlation coefficient was calculated for the variables *collaborative and organisational skills* and *not having enough digital educational resources.* In general there is a very weak, negative correlation, r_s (422) = -.131, p < .01, showed in Table 4.15.

Table 4.15: Collaborative and organisational skills/Insufficient digital educational resources

Item		r_s
Insufficient digital educational resources for instruction		r_s (422) = -.131, p < .01
Gender	Male	r_s (353) = -.137, p < .01
	Female	r_s (64) = -.066, p = .602
Home computer access	No	r_s (28) = -.021, p = .917
	Yes	r_s (362) = -.14, p < .01
Home computer use	School-related activities	r_s (281) = .008, p = .898
	Connecting to the Internet	r_s (133) = -.115, p = .188

In the case of male principals, r_s (353) = -.137, p < .01 and principals who have computers at home, r_s (362) = -.14, p < .01 there is a very weak, negative correlation.

A weak, negative correlation was found between the *variables teachers lacking ICT skills* and *collaborative and organisational skills* in general, with r_s (421) = -.159, p < .01. This is illustrated in Table 4.16.

Table 4.16: Collaborative and organisational skills/Teachers' lack of ICT skills

Item		r_s
Teachers' lack of ICT skills		r_s (421) = -.159, p < .01
Gender	Male	r_s (352) = -.166, p < .01
	Female	r_s (64) = -.086, p = .501
Home computer access	No	r_s (28) = -.012, p = .951
	Yes	r_s (361) = -.178, p < .01
Home computer use	School-related activities	r_s (280) = -.007, p = .907
	Connecting to the Internet	r_s (132) = -.144, p = .099

Again, a very weak, negative correlation was found in the case of male principals, r_s (352) = -.166, p < .01 and principals with home computer access, r_s (361) = -.178, p < .01.

4.4.4 To develop learners' independence and responsibility for their own learning

Spearman's rho correlation coefficient was calculated to find the relationship between *developing learners' independence and responsibility for their own learning* and the obstruction to implementing ICT of having *insufficient qualifies technical staff that is able to support ICT use*. In general, the correlation was negative and very weak, r_s (418) = -.127, p < .01, as seen in Table 4.17.

Table 4.17: Independence and responsibility/Insufficient qualified technical personnel

Item		r_s
Insufficient qualified technical staff that is able to support ICT use		r_s (418) = -.127, p < .01
Gender	Male	r_s (350) = -.11, p < .05
	Female	r_s (63) = -.86, p = .144
Home computer access	No	r_s (28) = -.036, p = .854
	Yes	r_s (359) = -.152, p < .01
Home computer use	School-related activities	r_s (279) = -.062, p = .305
	Connecting to the Internet	r_s (133) = -.155, p = .187

For male principals the variables showed a very weak, negative correlation, r_s (350) = -.11, p < .05. There was also a very weak, negative correlation in the case of principals who have home computer access, r_s (359) = -.152, p < .01.

Spearman's correlation coefficient was calculated to determine the relationship between *teaching independence and responsibility for learners' own learning* and *insufficient ICT equipment for instruction*. Table 4.18 shows a very weak, negative correlation between the variables, in general, r_s (417) = -.15, p < .01.

Table 4.18: Independence and responsibility/Insufficient ICT equipment for instruction

Item		r_s
Insufficient ICT equipment for instruction		r_s (417) = -.15, p < .01
Gender	Male	r_s (349) = -.145, p < .01
	Female	r_s (63) = -.142, p = .265

Table 4.18: Independence and responsibility/Insufficient ICT equipment for instruction (continued)

Item		r_s
Home computer access	No	r_s (27) = -.089, p = .66
	Yes	r_s (359) = -.164, p < .01
Home computer use	School-related activities	r_s (279) = -.044, p = .468
	Connecting to the Internet	r_s (132) = -.237, p < .01

In the case of male principals there was a very weak, negative correlation, r_s (349) = -.145, p < .01, as well as with principals who have home computers, r_s (359) = -.164, p < .01, For principals who use their home computers to connect to the Internet, there is a weak, negative correlation, r_s (132) = -.237, p < .01.

In general there is a very weak, negative correlation between the variables *developing learners' independence and responsibility for their own learning* and *computers being out of date*, r_s (417) = -.119, p < .05. The results are tabulated in Table 4.19.

Table 4.19: Independence and responsibility/Computers are outdated

Item		r_s
Computers are outdated		r_s (417) = -.119, p < .05
Gender	Male	r_s (349) = -.145, p < .01
	Female	r_s (63) = .007, p = .957
Home computer access	No	r_s (28) = .006, p = .977
	Yes	r_s (357) = -.115, p < .05
Home computer use	School-related activities	r_s (276) = .013, p = .828
	Connecting to the Internet	r_s (133) = -.179, p < .05

For the male principal layer variable, the correlation is very weak and negative, r_s (349) = -.145, p < .01. This is also the case for principals with home computer access, r_s (357) = -.115, p < .05 and those using their home computers to connect to the Internet, r_s (133) = -.179, p < .05.

Spearman's rho correlation coefficient was calculated to determine the relationship between *responsibility for own learning* and *not having enough digital educational resources* In general; there was a very weak, negative correlation, r_s (422) = -.149, p < .01, as illustrated in Table 4.20.

Table 4.20: Independence and responsibility/Insufficient digital educational resources

Item		r_s
Insufficient digital educational resources for instruction		r_s (422) = -.149, p < .01
Gender	Male	r_s (353) = -.149, p < .01
	Female	r_s (64) = -.124, p = .33
Home computer access	No	r_s (28) = .041, p = .836
	Yes	r_s (362) = -.164, p < .01
Home computer use	School-related activities	r_s (281) = -.037, p = .534
	Connecting to the Internet	r_s (133) = -.151, p = .083

A very weak, negative correlation exists in the case of male principals, r_s (353) = -.149, p < .01, all South African principals with home computer access, r_s (362) = -.164, p < .01 and principals connecting to the Internet using their home computers, r_s (133) = -.151, p = .083.

Spearman's correlation coefficient, calculated for the variables *independence and* responsibility for own learning and *teachers' lacking of ICT skills* shows a very weak, negative correlation in general, r_s (421) = -.102, $p < .05$. This is displayed in Table 4.21.

Table 4.21: Independence and responsibility/Teachers' lack of ICT skills

Item		r_s
Teachers' lack of ICT skills		r_s (421) = -.102, $p < .05$
Gender	Male	r_s (352) = -.105, $p < .05$
	Female	r_s (64) = -.049, $p = .699$
Home computer access	No	r_s (28) = .005, $p = .981$
	Yes	r_s (361) = -.113, $p < .05$
Home computer use	School-related activities	r_s (280) = .032, $p = .591$
	Connecting to the Internet	r_s (132) = -.108, $p = .216$

Here there is a very weak correlation in the case of male principals, r_s (352) = -.105, $p < .05$, as well as principals who have access to computers at home, r_s (361) = -.113, $p < .05$. In both cases the direction of the correlation is negative.

4.5 Conclusion

Spearman's correlation coefficient was calculated to assess the strength and direction of the relationship between obstructions to ICT implementation and the importance of ICT use for 21st Century Skills Development. The significance value (p) indicates whether the relationship is significant or not. Where significant correlations have been found the direction of the relationship was considered. It was found that all the significantly related variables have a negative relationship.

Therefore, overall there was a very weak, negative, yet significant correlation between Question 3 (importance of ICT for 21st Century Skills Development) and Question 16 (obstructions to ICT implementation). Increases in items from Question 16 were correlated with decreases in items from Question 3. The results of the analysis are summarised in the following chapter.

Chapter 5

Summary, conclusions and recommendations

5.1 Introduction

In this chapter conclusions from the findings are drawn, indicating their implications as well as recommendations for the application of the findings. The chapter is concluded by suggestions for further studies.

5.2 Summary of results

Section 5.2.1 – 5.2.4 provide a summary of the results. The summary is divided into four sections, corresponding with the four 21st Century skills that were focused on during this study.

5.2.1 To prepare learners for future work

The findings for the ICT goal for developing 21st Century Skills to prepare learners for future work is summarised in Table 5.1.

Table 5.1: To prepare learners for future work

		Insufficient qualified technical personnel	Insufficient ICT equipment	Computers are outdated	Insufficient digital educational resources	Teachers lack ICT skills
Preparing for future work		r_s (416) = -.185, p < 0.01	r_s (415) = -.155, p < 0.01	r_s (415) = -.169, p < 0.01	r_s (420) = -.175, p < 0.01	r_s (419) = -.153, p < 0.01
Gender	**Male**	r_s (348) = -.176, p < 0.01	r_s (347) = -.157, p < 0.01	r_s (347) = -.21, p < 0.01	r_s (351) = -.18, p < 0.01	r_s (350) = -.171, p < 0.01
	Female	r_s (63) = -.195, p = 0.125	r_s (63) = -.104, p = 0.417	r_s (63) = .033, p = 0.8	r_s (64) = -.110, p = 0.386	r_s (64) = -.013, p = 0.92
Computer access at home	**No**	r_s (28) = -.097, p = 0.622	r_s (27) = -.156, p = 0.436	r_s (28) = -.207, p = 0.29	r_s (28) = -.116, p = 0.557	r_s (28) = -.064, p = 0.746
	Yes	r_s (357) = -.2, p < 0.01	r_s (357) = -.147, p < 0.01	r_s (355) = -.145, p < 0.01	r_s (360) = -.183, p < 0.01	r_s (359) = -.147, p < 0.01
Home computer use	**School-related activities**	r_s (277) = -.115, p = 0.056	r_s (277) = -.009, p = 0.878	r_s (274) = -.003, p = 0.962	r_s (279) = -.055, p = 0.359	r_s (278) = -.038, p = 0.523
	Connecting to the Internet	r_s (133) = -.189, p < .05	r_s (132) = -.238, p < .01	r_s (133) = -.201, p < .05	r_s (133) = -.232, p < .01	r_s (132) = -.175, p < .05

From Table 5.1 the following conclusions can be drawn:

- *Not having enough qualified technical personnel* that can support ICT use for 21st Century Skills Development impacts negatively on the importance of preparation for future work. It also affects schools with male principals in the same way, as well as schools with principals who have computer access at home. This impact is less significant on principals who use their home computers to connect to the Internet.
- *Insufficient ICT equipment* impacts negatively on the importance of preparing learners for future work. This holds true for schools with male principals, principals with home computer access and where principals use their home computers to connect to the Internet.
- The importance attached to *preparing learners for the world of work*, using ICT for 21st Century Skills Development, is hindered by school computers being outdated. This hindrance can also be observed in schools with male principals, principals who have home computers and in the case of principals who use their home computers to access the Internet.
- *Having insufficient digital educational resources* in schools also creates an obstruction in South African schools' plans to use ICT to prepare learners for future work. This obstruction is also experienced in schools with male principals, schools whose principals have home computers and where principals use their home computers for Internet access.
- From Table 5.1 it can be seen that schools attach less importance to *preparing their learners for future work*, using ICT, when their teachers lack ICT skills. This has also been observed in the case of schools with male principals, in schools whose principals have computer access at home and principals who use their computers at home to access the Internet.

5.2.2 To promote active learning strategies

Table 5.2 summarises the results for the ICT goal to promote active learning strategies.

Table 5.2: To promote active learning strategies

		Insufficient qualified technical personnel	Insufficient ICT equipment	Computers are outdated	Insufficient digital educational resources	Teachers lack ICT skills
Promoting active learning strategies		r_s (417) = -.190, p < 0.01	r_s (416) = -.157, p < 0.01	r_s (416) = -.134, p < 0.01	r_s (421) = -.159, p < 0.01	r_s (420) = -.156, p < 0.01
Gender	**Male**	r_s (349) = -.174, p < 0.01	r_s (348) = -.163, p < 0.01	r_s (348) = -.172, p < 0.01	r_s (352) = -.166, p < 0.01	r_s (351) = -.171, p < 0.01
	Female	r_s (63) = -.212, p = 0.095	r_s (63) = -.091, p = 0.476	r_s (63) = .032, p = 0.806	r_s (64) = -.086, p = 0.498	r_s (64) = -.054, p = 0.673
Computer access at home	**No**	r_s (28) = -.087, p = 0.661	r_s (27) = -.165, p = 0.411	r_s (28) = -.16, p = 0.417	r_s (28) = -.175, p = 0.372	r_s (28) = .039, p = 0.843
	Yes	r_s (358) = -.212, p < 0.01	r_s (358) = -.162, p < 0.01	r_s (356) = -.122, p < 0.05	r_s (361) = -.155, p < 0.01	r_s (360) = -.172, p < 0.01
Home computer use	**School-related activities**	r_s (279) = -.13, p < 0.05	r_s (279) = -.043, p = 0.472	r_s (276) = -.013, p = 0.83	r_s (281) = -.041, p = 0.495	r_s (280) = -.044, p = 0.466
	Connecting to the Internet	r_s (133) = -.165, p = .057	r_s (132) = -.262, p < .01	r_s (133) = -.164, p = .059	r_s (133) = -.168, p = .054	r_s (132) = -.174, p < .05

The following conclusions can be drawn from Table 5.2:

- The importance of ICT *to promote active learning strategies* is influenced negatively by the obstruction of *not having sufficient qualified technical staff that is able to support ICT use*. The same sentiment was expressed by male principals, principals who have computer access at home, as well as principals who use their home computers for school-related activities.
- *Having insufficient ICT equipment* has a negative impact on schools' promotion of active learning strategies through ICT. Male principals, principals with computers at home and principals using their home computers to access the Internet also experience this obstruction.
- Schools with *computers that are out of date* attach less importance to the ICT goal *to promote active learning strategies*. Male principals and principals with access to a computer at home feel the same way.
- *Not having enough digital educational resources* impacts negatively on the importance attached to *the promotion of active learning strategies*. Male principals and principals who have home computers also experience this.
- Furthermore it was found that in schools where *teachers lack ICT skills*, there is a negative impact on the importance of the *promotion of active learning strategies* in learners. Male principals, principals with computer access at home and those using their home computers to access the Internet shared the same sentiment.

5.2.3 To practise collaborative and organisational skills

Table 5.3 summarises the results found for the relationship between the ICT goal of *practising collaborative and organisational skills* and the obstructions under investigation.

Table 5.3: To practice collaborative and organisational skills

		Insufficient qualified technical staff	Insufficient ICT equipment	Computers are outdated	Insufficient digital educational resources	Teachers lack ICT skills
Practising collaborative and organisational skills		r_s (418) = -.167, p < 0.01	r_s (417) = -.177, p < 0.01	r_s (417) = -.118, p < 0.05	r_s (422) = -.131, p < 0.01	r_s (421) = -.159, p < 0.01
Gender	**Male**	r_s (350) = -.149, p < 0.01	r_s (349) = -.18, p < 0.01	r_s (349) = -.143, p < 0.01	r_s (353) = -.137, p < 0.01	r_s (352) = -.166, p < 0.01
	Female	r_s (63) = -.205, p = 0.106	r_s (63) = -.125, p = 0.329	r_s (63) = -.004, p = 0.973	r_s (64) = -.066, p = 0.602	r_s (64) = -.086, p = 0.501
Computer access at home	**No**	r_s (28) = -.08, p = 0.685	r_s (27) = -.15, p = 0.456	r_s (28) = -.038, p = 0.849	r_s (28) = -.021, p = 0.917	r_s (28) = -.012, p = 0.951
	Yes	r_s (359) = -.193, p < 0.01	r_s (359) = -.191, p < 0.01	r_s (357) = -.11, p < 0.05	r_s (362) = -.14, p < 0.01	r_s (361) = -.178, p < 0.01
Home computer use	**School-related activities**	r_s (279) = -.089, p = 0.139	r_s (279) = -.044, p = 0.468	r_s (276) = .023, p = 0.698	r_s (281) = .008, p = 0.898	r_s (280) = -.007, p = 0.907
	Connecting to the Internet	r_s (133) = -.139, p = .111	r_s (132) = -.245, p < .01	r_s (133) = -.099, p = .257	r_s (133) = -.115, p = .188	r_s (132) = -.144, p = .099

- An *insufficiency of qualified technical staff that can support ICT use* impacts negatively on the importance attached to the *development of learners' independence and responsibility*. This is also experienced by male principals and principals with home computer access.
- Having *insufficient ICT equipment* makes the advancement of *collaborative and organisational skills* less of a priority in schools. Male principals feel the same way in this regard, as do principals with home computers and principals using their home computers for Internet access.
- Schools whose *computers are out of date* attach less importance to the *practising of collaborative and organisational skills*. Male principals, principals with home computer access and principals who use their home computers for Internet use also express this view.
- *Insufficient digital educational resources* causes schools to attach less importance to the ICT goal of *practising collaborative and organisational skills* in their learners. This is also experienced by male principals and principals who have access to a computer at home.
- In schools where *teachers lack ICT skills*, *practising collaborative and organisational skills* is not considered to be a very important goal. Of the same opinion are male principals and principals with home computer access.

5.2.4 To develop independence and responsibility for learning

Table 5.4 presents a summary of the results of the ICT goal to teach learners *to become independent and take responsibility for their own learning*, from which the following conclusions can be drawn:

- Having *insufficient qualified technical staff* has a negative impact on the importance of the goal to *encourage learners to become independent and take responsibility for their own learning*. This is also the sentiment of male principals and principals who have computer access at home.

Table 5.4: To develop independence and responsibility

		Insufficient qualified technical staff	Insufficient ICT equipment	Computers are outdated	Insufficient digital educational resources	Teachers lack ICT skills
Developing independence and responsibility		r_s (418) = -.127, $p < 0.01$	r_s (417) = -.15, $p < 0.01$	r_s (417) = -.119, $p < 0.05$	r_s (422) = -.149, $p < 0.01$	r_s (421) = -.102, $p < 0.05$
Gender	**Male**	r_s (350) = -.11, $p < 0.05$	r_s (349) = -.145, $p < 0.01$	r_s (349) = -.145, $p < 0.01$	r_s (353) = -.149, $p < 0.01$	r_s (352) = -.105, $p < 0.05$
	Female	r_s (63) = -.86, $p = 0.144$	r_s (63) = -.142, $p = 0.265$	r_s (63) = .007, $p = 0.957$	r_s (64) = -.124, $p = 0.33$	r_s (64) = -.049, $p = 0.699$
Computer access at home	**No**	r_s (28) = -.036, $p = 0.854$	r_s (27) = -.089, $p = 0.66$	r_s (28) = .006, $p = 0.977$	r_s (28) = .041, $p = 0.836$	r_s (28) = .005, $p = 0.981$
	Yes	r_s (359) = -.152, $p < 0.01$	r_s (359) = -.164, $p < 0.01$	r_s (357) = -.115, $p < 0.05$	r_s (362) = -.164, $p < 0.01$	r_s (361) = -.113, $p < 0.05$
Home computer use	**School-related activities**	r_s (279) = -.062, $p = 0.305$	r_s (279) = -.044, $p = 0.468$	r_s (276) = .013, $p = 0.828$	r_s (281) = -.037, $p = 0.534$	r_s (280) = .032, $p = 0.591$
	Connecting to the Internet	r_s (133) = -.155, $p = .187$	r_s (132) = -.237, $p < .01$	r_s (133) = -.179, $p < .05$	r_s (133) = -.151, $p = .083$	r_s (132) = -.108, $p = .216$

- *Insufficient ICT equipment* at school was also found to impact negatively on the importance attached to the *development of learners' independence and responsibility for their own learning*. This view was also expressed by male principals, principals with home computer access and principals who use their home computers to access the Internet.
- Schools whose *computers are outdated* attach less importance to the *development of independence and responsibility for learners' own learning*. Male principals were also found to regard the development of independence and responsibility for learning as less of a priority and so did principals who have computer access at home and those using their home computers for Internet access.
- *Schools lacking digital educational resources* regard the *development of independence and responsibility for own learning* in their learners as a less important goal. This view is shared by male principals and principals with computer access at home.
- *Teachers lacking ICT skills* impact negatively on the importance of the *development of independence and responsibility for learning*. Male principals and principals with computer access at home also feel this way.

5.3 Discussion and implications of results

It can be inferred that South African principals at whose schools Mathematics and Science are taught to Grade 8 learners, perceive insufficient qualified technical staff, insufficient ICT equipment, computers that are outdated, insufficient digital educational resources and teachers who lack ICT skills as factors impacting negatively on the importance of ICT goals for 21st Century Skills Development. An overview of the results is found in Table 5.5.

Table 5.5: Overview of results

		Insufficient qualified technical staff	Teachers lack ICT skills	Computers are outdated	Insufficient digital educational resources	Insufficient ICT equipment for instruction
Prepare for future work		✓	✓	✓	✓	✓
Gender	**Male**	✓	✓	✓	✓	✓
	Female					
Computer access at home	**No**					
	Yes	✓	✓	✓	✓	✓
Home computer use	**School act.**[23]					
	Internet	✓			✓	
Promote active learning		✓	✓	✓	✓	✓
Gender	**Male**	✓	✓	✓	✓	✓
	Female					
Computer access at home	**No**					
	Yes	✓	✓	✓	✓	✓
Home computer use	**School act.**	✓				
	Internet	✓	✓	✓	✓	
Practice coll.[24] **& org.**[25] **skills**		✓	✓	✓	✓	✓
Gender	**Male**	✓	✓	✓	✓	✓
	Female					

[23] activities
[24] collaborative
[25] organisational

Table 5.5: Overview of results (continued)

Computer access at home	**No**					
	Yes	✓	✓	✓	✓	✓
Home computer use	**School act.**					
	Internet	✓	✓		✓	✓
Develop indep.[26] & resp.[27]		✓	✓	✓	✓	✓
Gender	**Male**	✓	✓	✓	✓	✓
	Female					
Computer access at home	**No**					
	Yes	✓	✓	✓	✓	✓
Home computer use	**School act.**					
	Internet	✓				

Based on the results, the following research questions can be answered:

- What is the relationship between the importance of ICT use for 21st Century Skills Development and obstructions hindering ICT goals in the light of currently available *Infrastructure* in South African schools?

Having insufficient ICT equipment, computers being outdated and having insufficient digital educational resources all impact negatively on the importance of ICT use for 21st Century Skills Development in schools, according to school principals. This negative impact of infrastructure-related obstructions was also found to affect mostly male principals and principals with computer access at home.

[26] independence
[27] responsibility

- What is the relationship between the importance of ICT use for 21st Century Skills Development and obstructions hindering ICT goals in the light of currently available *Human Resources* in South African schools?

Insufficient human resources – insufficient qualified technical staff members and teachers lacking ICT skills – impact negatively on all the ICT goals that have been investigated. The schools that were found to be affected most markedly are schools with male principals and schools whose principals have computer access at home.

Both a lack of Infrastructure and human resources greatly impact on the importance of ICT for 21st Century Skills Development in preparing learners for future work in the case of schools whose principals use their home computers to access the Internet.

For learners to truly gain applicable skills and knowledge, teaching 21st Century Skills needs to be part of the curriculum. Syllabuses need to be adapted, teaching facilities have to be upgraded and pedagogical practices need to be modified. This means implementing change on a large scale – change that will definitely not be met without resistance.

Various obstructions to ICT implementation are identified in the literature and they are classified in different ways. Pelgrum (2001, p. 164) differentiates between micro- and meso-level forces. Balinskat, Blamire and Kefala (2006, p. 57) explain that the macro-level is equated to teacher level barriers, the meso-level to school level barriers and the macro-level to system level barriers.

They go on to explain that at macro-level, teachers still lack ICT skills. At meso-level infrastructure and ICT access are either insufficient or missing completely. At this level there is also a lack of leadership and strategies for implementing and maintaining ICTs (p. 58). Lastly, teachers still seem to cling to traditional teaching methods for fear of underperforming and not reaching standard goals (p. 58).

Looking at infrastructure, the literature seems to agree that a shortage of equipment causes obstructions to ICT implementation. Goktas and Yildirim (2009, pp. 197-198), also mention this. They include, among others, appropriate software, hardware and materials; classrooms; computers; presentation equipment and computer labs for use in free time. They mention that routines for using ICTs still need to be established, because ICTs are still new. This is not only true when ICTs are integrated for the first time in a specific educational setting, but also when newer software and hardware are purchased.

What has also been found is that insufficient time to use ICTs and equipment (Al-Senaidi, Lin & Poirot, 2009, p. 575), and too little resources in general (Bringimlas, 2009; Goktas & Yildirim, 2009) are problematic. In the case of Australian schools, Courtney and Anderson (2010) explicate differences between ICT use at schools versus ICT use at home. At home learners have fast, unblocked Internet access, while access is slow and restricted at school (p. 9). Therefore, just as in South African schools, hardware needs to be updated. In Australian schools these inconsistencies are reported to cause angst and frustration (p. 7).

Schools are also short of staff with the necessary competence (Bingimlas, 2009, p. 235) and training (Schneckenberg, 2010, p. 985), just as is the case in South African schools. The lack of in-service training can be made worse by the deficiency in institutional support (Al-Senaidi et al., 2009, p. 575) and absence of motivation and role models (Gotkas & Yildirim, 2009, p. 198). Furthermore Schneckenberg (2010, p. 989) talks about the rapid disruptive advancement of technology that makes sustainable (ICT) integration a challenge (p. 980).

However, Gotkas and Yildirim (2009, p. 197) found mostly neutral responses – to the lack of appropriate course content and instructional programs, time constraints, and lack of administrative support in their research – with deans and teacher educators. Also, Drent and Meelissen (2008, p. 193) mention teachers' ability to use ICT as not having a direct influence on innovative ICT use, according to their findings.

Lastly, where learners in many countries have very little or no access to any ICTs, learners in Queensland, Australia, simply seem to be turned-off by the lower level of ICTs available at

school, as opposed to what they are used to at home (Courtney & Anderson, 2010). One could say that a country's ICT culture predetermines what type of obstacles its schools might encounter with regard to ICT implementation.

Principals' input is needed to start and maintain this process. To achieve the outcomes one must produce specific objects – in other words, ICT needs to be implemented in the core subjects (Mathematics and Science) in order for principals to be able to achieve the outcomes for their schools. The outcomes, of course, are to prepare learners for future work; to promote strategies for active learning; to develop learners' independence and responsibility; and to practise collaborative and organisational skills.

However, it has been found that the outcomes are thwarted by obstructions to ICT implementation. The obstructions are human resource-related (insufficient technical personnel and teachers lacking ICT skills) and infrastructure-related (insufficient ICT equipment; computers being outdated and insufficient digital educational resources). These obstructions prevent principals from achieving the ICT outcomes for their schools. Therefore, in order to be able to achieve those outcomes, the obstructions to ICT implementation need to be eliminated.

5.4 Conclusions

A secondary data analysis has been conducted, drawing on data from SITES 2006 to investigate the correlation between factors influencing ICT implementation and the importance of ICT use for 21st Century Skills Development. It has been found that all the factors under investigation have a negative influence, causing obstructions to ICT implementation. Consistent with international findings are insufficient equipment, outdated hardware and teachers lacking ICT skills.

If these obstructions to ICT use persist, South African schools will have great difficulty, if not complete failure, to teach their learners 21st Century Skills. In other words, if the

obstructions should increase, the schools' ability to prepare their learners for the future, using ICT can never increase.

5.5 Recommendations

In future, the distribution of resources for ICT implementation should be considered more carefully. A good starting point would be to give priority to schools with ICT plans and the required funding to implement them, as was done in Chile (see Howie, 2010). Furthermore, schools could be divided into groups according to certain characteristics (for example the ICT skill level of teachers) and then receive resources for ICT implementation, allocated to target specific needs.

Furthermore, ICT plans should be tested in a limited number of schools, taking small steps during the initiation phases, instead of bulldozing in the wrong direction, as is often seen. These plans should be customised to suit the schools' circumstances and characteristics. Then, based on the resulting outcomes, the ICT plans can be adjusted and adopted by other schools.

Further research is required to determine which specific circumstances and school characteristics contribute to successful ICT implementation. Furthermore, cross-study research, using various IEA studies, could be conducted to gain a clearer all-round understanding of the situation in schools. Results from such research can provide in-depth information for needs assessment and development programmes. The time has come, perhaps, to consider taking on more longitudinal studies, using IEA data.

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Addendum A:

Questionnaires

Pedagogy and ICT in your school

This section asks you to answer questions about pedagogy and ICT in your school.

3. For each of the following, how important is the use of ICT at Grade <target grade> in your school?
Please mark only one choice in each row.

		1 Not at all disagree	2 A little	3 Somewhat	4 A lot agree
A	To prepare students for the world of work BCP03A1	☐	☐	☐	☐
B	To improve students' performance on assessments/examinations BCP03B1	☐	☐	☐	☐
C	To promote active learning strategies BCP03C1	☐	☐	☐	☐
D	To individualize student learning experiences in order to address different learning needs BCP03D1	☐	☐	☐	☐
E	To foster collaborative and organizational skills when working in teams BCP03E1	☐	☐	☐	☐
F	To develop students' independence and responsibility for their own learning BCP03F1	☐	☐	☐	☐
G	To do exercises to practice skills and procedures BCP03G1	☐	☐	☐	☐
H	To increase learning motivation and make learning more interesting BCP03H1	☐	☐	☐	☐
I	To satisfy parents' and the community 's expectations BCP03I1	☐	☐	☐	☐
J	To act as a catalyst in changing the pedagogical approaches of teachers BCP03J1	☐	☐	☐	☐

Obstacles

16. To what extent is your school's capacity to realize its pedagogical goals hindered by each of the following obstacles?

Please mark only one choice in each row.

		1 Not at all	2 A little	3 Somewhat	4 A lot	5 Not applicable
ICT-related obstacles						
A	Insufficient qualified technical personnel to support the use of ICT BCP16A1	☐	☐	☐	☐	☐
B	Insufficient number of computers connected to the Internet BCP16B1	☐	☐	☐	☐	☐
C	Insufficient Internet bandwidth or speed BCP16C1	☐	☐	☐	☐	☐
D	Lack of special ICT equipment for disabled students BCP16D1	☐	☐	☐	☐	☐
E	Insufficient ICT equipment for instruction BCP16E1	☐	☐	☐	☐	☐
F	Computers are out of date BCP16F1	☐	☐	☐	☐	☐
G	Not enough digital educational resources for instruction BCP16G1					
H	Lack of ICT tools for science laboratory work BCP16H1	☐	☐	☐	☐	☐
I	Teachers' lack of ICT skills BCP16I1	☐	☐	☐	☐	☐
J	Insufficient time for teachers to use ICT BCP16J1	☐	☐	☐	☐	☐
Other obstacles						
K	Pressure to score highly on standardized tests BCP16K1	☐	☐	☐	☐	☐
L	Prescribed curricula are too strict BCP16L1	☐	☐	☐	☐	☐
M	Insufficient or inappropriate space to accommodate the school's pedagogical approaches BCP16M1	☐	☐	☐	☐	☐
N	Insufficient budget for non ICT-supplies (e.g., paper, pencils) BCP16N1	☐	☐	☐	☐	☐
O	Using ICT for teaching and/or learning is not a goal of our school BCP16O1	☐	☐	☐	☐	☐

Addendum B:

Ethical clearance documentation

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Faculty of Education

RESEARCH ETHICS COMMITTEE

CLEARANCE CERTIFICATE	**CLEARANCE NUMBER :** SM 12/06/02
DEGREE AND PROJECT	MEd Factors influencing 21st century skills development sustained by ICT
INVESTIGATOR(S)	Erna Laubscher
DEPARTMENT	Science, Mathematics and Technology Education
DATE CONSIDERED	19 November 2012
DECISION OF THE COMMITTEE	APPROVED

Please note:
For Masters applications, ethical clearance is valid for 2 years
For PhD applications, ethical clearnace is valid for 3 years.

ACTING CHAIRPERSON OF ETHICS COMMITTEE Dr. Suzanne Bester

DATE 19 November 2012

CC Jeannie Beukes
J.G. Knoetze

This ethical clearance certificate is issued subject to the following conditions:

1. A signed personal declaration of responsibility
2. If the research question changes significantly so as to alter the nature of the study, a new application for ethical clearance must be submitted
3. It remains the students' responsibility to ensure that all the necessary forms for informed consent are kept for future queries.

Please quote the clearance number in all enquiries.

Subject:	Re: Permission to use SITES 2006 data
From:	erna laubscher (erna_laubscher@yahoo.com)
To:	Sarah.Howie@up.ac.za;
Date:	Monday, August 20, 2012 5:32 AM

Good day Prof Howie,

Thank you for granting me access to the data.

I would like to know more about your suggestion regarding triangulation. Your advice would be greatly appreciated.

Kind regards

Erna Laubscher

From: Sarah Howie <Sarah.Howie@up.ac.za>
To: erna laubscher <erna_laubscher@yahoo.com>
Cc: "jknoetze@mweb.co.za" <jknoetze@mweb.co.za>
Sent: Monday, August 13, 2012 7:04 PM
Subject: Re: Permission to use SITES 2006 data

Dear Erna

I re-read your letter with the information about your study and saw the items you wanted to use. That would be in order and we would be most willing to grant you access to the data.

When I saw the items you wanted to use, I wondered whether you have considered triangulating the information with data from the other instruments?

warm regards
Sarah

>>> erna laubscher <erna_laubscher@yahoo.com> 2012/08/13 10:02 AM >>>

Good day Prof. Howie,

I have received ethics clearance and would like to request permission to use SITES 2006 data for my MEd dissertation. Please find the signed letter of permission, attached.

Kindly respond at your earliest convenience.

Thank you in advance.

Sincerely,

Erna Laubscher

072 287 3540
erna_laubscher@yahoo.com

Addendum C:

Declaration of Originality

Declaration of originality: University of Pretoria

The Department of …… places great emphasis upon integrity and ethical conduct in the preparation of all written work submitted for academic evaluation.

While academic staff teaches you about referencing techniques and how to avoid plagiarism, you too have a responsibility in this regard. If you are at any stage uncertain as to what is required, you should speak to your lecturer before any written work is submitted.

You are guilty of plagiarism if you copy something from another author's work (e.g. a book, an article or a website) without acknowledging the source and pass it off as your own. In effect you are stealing something that belongs to someone else. This is not only the case when you copy work word-for-word (verbatim), but also when you submit someone else's work in a slightly altered form (paraphrase) or use a line of argument without acknowledging it. You are not allowed to use work previously produced by another student. You are also not allowed to let anybody copy your work with the intention of passing if off as his/her work.

Students who commit plagiarism will not be given any credit for plagiarised work. The matter may also be referred to the Disciplinary Committee (Students) for a ruling. Plagiarism is regarded as a serious contravention of the University's rules and can lead to expulsion from the University.

The declaration which follows must accompany all written work submitted while you are a student of the Department of ..... No written work will be accepted unless the declaration has been completed and attached.

Full names of student:

.....

Student number:

.....

Topic of work:

.....

Addendum D (CD):

Descriptive analysis

Inferential analysis:

- **Computer use (layer variable)**
- **Gender (layer variable)**
- **Home computer (layer variable)**
- **Main analysis**